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1998 INEEL National Emission Standard for Hazardous Air Pollutants - Radionuclides

Annual Report
June 1999

INEEL
IDAHO NATIONAL ENGINEERING & ENVIRONMENTAL LABORATORY

1998 Idaho National Engineering and Environmental Laboratory (INEEL) National Emission Standards for Hazardous Air Pollutants (NESHAPs) - Radionuclides Annual Report

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U. S. DEPARTMENT OF ENERGY

RADIONUCLIDE AIR EMISSIONS ANNUAL REPORT

(under Subpart H of 40 CFR 61)

CALENDAR YEAR 1998

Site Name: Idaho National Engineering and Environmental Laboratory

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ACRONYMS

ANL	Argonne National Laboratory
ANL-W	Argonne National Laboratory - West
ATR	Advanced Test Reactor
CAM	constant air monitor
CEDE	committed effective dose equivalent
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CY	calendar year
DOE	Department of Energy
DOE-CH	Department of Energy, Chicago Operations Office
DOE-ID	Department of Energy, Idaho Operations Office
DU	depleted uranium
DVF	Drum Venting Facility
EBR-II	Experimental Breeder Reactor-II
ECF	Expended Core Facility
EDE	effective dose equivalent
EPA	Environmental Protection Agency
FASB	Fuel Assembly and Storage Building
FAST	Fluorinel and Storage Facility
FCF	Fuel Conditioning Facility
FHU	fuel handling unit
FMF	Fuel Manufacturing Facility
Foundation	Environmental Science and Research Foundation
HEPA	high-efficiency particulate air
HEU	Highly Enriched Uranium
HFEF	Hot Fuel Examination Facility
HLLWE	High-Level Liquid Waste Evaporator
HLW	high-level waste
HP	health physics
HPIL	Health Physics Instrumentation Laboratory
HRF	heat recovery fan
HVAC	heating, ventilating, and air conditioning
INTEC	Idaho Nuclear Technical and Engineering Center
INEEL	Idaho National Engineering and Environmental Laboratory
IRC	INEEL Research Center
L&O	Laboratory and Office
LET&D	Liquid Effluent Treatment and Disposal
LMITCO	Lockheed Martin Idaho Technologies Company
mrem	millirem
MDF	Materials Development Facility
MEI	maximally exposed individual
MTR	Material Test Reactor
NCRP	National Council on Radiation Protection
NDA	nondestructive assay
NESHAPs	National Emission Standards for Hazardous Air Pollutants

ACRONYMS (continued)

NOAA	National Oceanic and Atmospheric Administration
NRC	Nuclear Regulatory Commission
NRF	Naval Reactors Facility
NWCF	New Waste Calcining Facility
PBF	Power Burst Facility
PEW	Process Equipment Waste
PHP	Plasma Hearth Process
PNR	Pittsburgh Naval Reactors
PRF	Process Reclamation Facility
QA	quality assurance
PRF	Process Reclamation Facility
RAL	Remote Analytical Laboratory
RESL	Radiological and Environmental Sciences Laboratory
RLWTF	Radioactive Liquid Waste Treatment Facility
RPSSA	Radioactive Parts Security Storage Area
RWMC	Radioactive Waste Management Complex
RWMIS	Radioactive Waste Management Information System
SCMS	Sodium Components Maintenance Shop
SDA	Subsurface Disposal Area
SMC	Specific Manufacturing Capability
SNF	spent nuclear fuel
STAR	Stability wind rose (STability ARray file)
SWEPP	Stored Waste Examination Pilot Plant
TAN	Test Area North
TRA	Test Reactor Area
TREAT	Transient Reactor Test Facility
TSA	Transuranic Storage Area
TSF	Technical Support Facility
WEC	Westinghouse Electric Company
WERF	Waste Experimental Reduction Facility
WIPP	Waste Isolation Pilot Plant
WROC	Waste Reduction Operations Complex
WSF	Waste Storage Facility
ZPPR	Zero Power Physics Reactor

EXECUTIVE SUMMARY

Under Section 61.94 of Title 40, Code of Federal Regulations (CFR), Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities," each Department of Energy (DOE) facility must submit an annual report documenting compliance. This report addresses the Section 61.94 reporting requirements for operations at the Idaho National Engineering and Environmental Laboratory (INEEL) for calendar year (CY) 1998. The Idaho Operations Office of the DOE is the primary contact concerning compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs) at the INEEL.

For CY 1998, airborne radionuclide emissions from the INEEL operations were calculated to result in a maximum individual dose to a member of the public of 8.10E-03 mrem (8.10E-08 Sievert). This effective dose equivalent (EDE) is well below the 40 CFR 61, Subpart H, regulatory standard of 10 mrem per year (1.0E-04 Sievert per year).

This report was prepared using the format suggested by DOE Headquarters. Section I provides an overview of the INEEL facilities and a brief description of the radioactive materials and processes at the facilities. Section II identifies radioactive air effluent release points (i.e., vents and stacks) and diffuse sources at the INEEL and actual releases during 1998. Section II also describes the effluent control systems for each potential release point. Section III provides the methodology and EDE calculations for 1998 INEEL radioactive emissions. Section IV provides information regarding construction or modification activities that occurred during 1998. Appendix A contains information specific to the Naval Reactors Facility (NRF) located within the INEEL reservation. However, the EDE information for NRF is reported in the EDE for the INEEL in order to demonstrate INEEL compliance with the 40 CFR 61, Subpart H, dose standard of 10 mrem per year (1.0E-04 Sievert per year). Appendix B contains information specific to the INEEL Research Center (IRC) because the IRC is not part of the INEEL's contiguous site (per the NESHAP's definition of "facility"). Appendices C and D provide supporting documentation used as input parameters for the CAP-88 computer code. Data, calculations, model runs, and other documentation used to develop this report are maintained on file at the INEEL in accordance with 40 CFR 61.95.

I. FACILITY INFORMATION

Site Description

The Idaho National Engineering and Environmental Laboratory (INEEL) of the Department of Energy (DOE) was established by the federal government in 1949 to conduct research and further the development of nuclear reactors and related equipment. Major DOE Programs at the INEEL include test irradiation services, waste management, light-water-cooled reactor safety testing and research, operation of research reactors, and environmental restoration. The INEEL is operated for DOE by various contractors. Major contractors at the INEEL include Lockheed Martin Idaho Technologies Company (LMITCO), Westinghouse Electric Company (WEC), and Argonne National Laboratory (ANL). These contractors conduct the various INEEL programs under the administration of three DOE field offices: Idaho Operations Office (DOE-ID), Chicago Operations Office (DOE-CH), and the Pittsburgh Naval Reactors Idaho Branch Office (PNR). DOE-ID is the primary contact concerning compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs) at the INEEL.

The INEEL encompasses approximately 890 square miles on the upper Snake River Plain in southeastern Idaho (Figure 1). The nearest INEEL boundaries to population centers are approximately 22 miles west of Idaho Falls, Idaho, 23 miles northwest of Blackfoot, Idaho, 44 miles northwest of Pocatello, Idaho, 7 miles east of Arco, Idaho, and 1 mile north of Atomic City, Idaho. In addition, individual farms and ranches are located near the INEEL boundaries. These receptors represent the locations used for demonstration of compliance with the NESHAPs' dose standard of 10 mrem per year effective dose equivalent (EDE). Section III provides information concerning distances from the INEEL emission sources to these locations and population densities from each operational area.

Climatology of the INEEL is characterized as semiarid. The location of the INEEL in a relatively flat valley surrounded by mountains, coupled with its approximately 5,000-foot altitude, affects its overall climate and day-to-day weather systems. Air masses entering the Snake River Plain from the west have lost most of their moisture to precipitation before passing over the INEEL. Therefore, annual precipitation at the INEEL is light. The orientation of the Snake River Plain and bordering mountain ranges channel the winds so that a southwest wind predominates over the INEEL. The second most frequent winds are from the northeast.

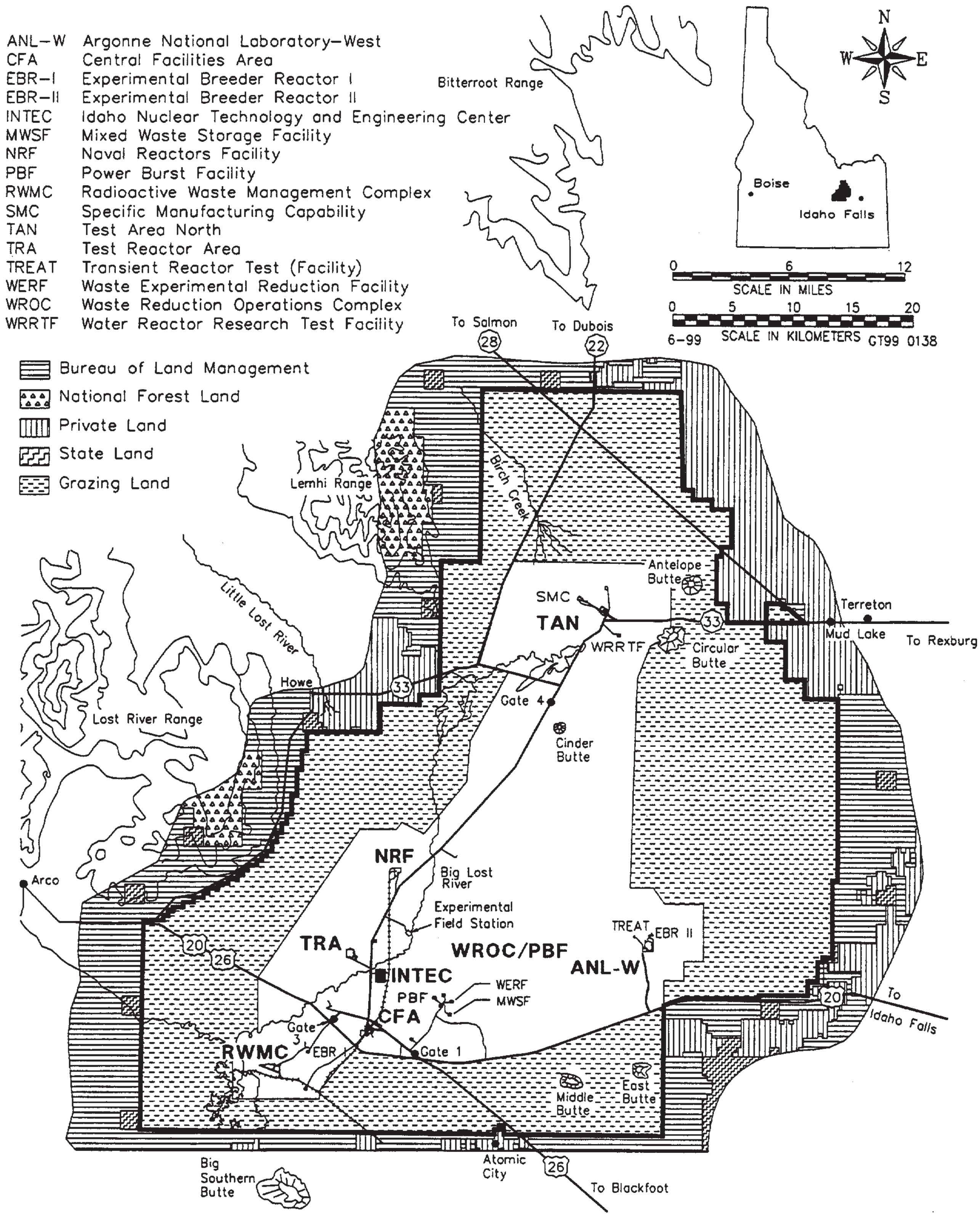

Figure 1. Idaho National Engineering and Environmental Laboratory and Major Facilities.

The annual average air temperature at the INEEL [measured at the Central Facilities Area (CFA)] is 42.0°F (5.6°C) with extremes of -47° F (-44 ° C) and 101° F (38° C). The average annual windspeed at CFA (20-ft level) is 7.5 mph (3.4 meters per second). The minimum average monthly windspeed of 5.1 mph (2.3 meters per second) occurs in December, and the maximum average monthly windspeed of 9.3 mph (4.2 meters per second) occurs in April and May. Calm conditions prevail approximately 11 % of the time (Clawson et al. 1989).

Average annual precipitation over the INEEL (as measured at CFA) is approximately 9 inches. Yearly totals have ranged from 4.5 to 14.4 inches. A portion of this precipitation is received as snowfall, which averages 28 inches per year (Clawson et al. 1989).

Topography of the INEEL is representative of the upper Snake River Plain as a whole. The INEEL surface is a combination of basalt, eolian, and alluvial sedimentary deposits. Vegetation and wildlife on the INEEL are typical of a cool, desert shrub biome.

The INEEL is subject to 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities." While the INEEL consists of a variety of operations spread over the 890-square-mile reservation, for purposes of compliance demonstration with the 40 CFR 61, Subpart H, dose standard of 10 mrem per year, the INEEL is defined as one facility. The final rule promulgating 40 CFR 61, issued December 15, 1989, specified ". . . that all buildings, structures and operations within one contiguous site shall be considered a single facility."

Operations that potentially emit radionuclides are located at various areas on the INEEL and can be grouped into eight distinct locations:

- Argonne National Laboratory - West (ANL-W)
- Central Facilities Area (CFA)
- Idaho Nuclear Technical and Engineering Center (INTEC)
- Naval Reactors Facility (NRF).
- Power Burst Facility (PBF) area, including the Waste Reduction Operations Complex (WROC)
- Radioactive Waste Management Complex (RWMC)
- Test Area North (TAN), which encompasses the Specific Manufacturing Capability (SMC) operation
- Test Reactor Area (TRA).

Figure 1 shows the location of these areas at the INEEL. A more detailed description of each of these areas, excluding the NRF, is provided below. The NRF area description is in Appendix A.

Area and Source Descriptions

Argonne National Laboratory - West

The ANL-W site is located on the southeastern corner of the INEEL in Bingham County, Idaho. ANL- W is operated for the DOE by the University of Chicago through the DOE-CH. ANL-W is a research facility that has contributed significantly to knowledge advancements in liquid metal fast breeder reactor technology and extreme condition fuels and reactor materials behavior. The present mission of ANL-W involves research related to spent nuclear fuel and waste treatment technologies, reactor shutdown activities and remediation projects.

The Experimental Breeder Reactor-II (EBR-II) defueling was completed in calendar year (CY) 1996. The reactor building is still being ventilated and monitored. The continuous monitoring is supplemented with postfiltration sampling and analysis for particulates. CY 1998 ancillary emissions associated with EBR-II operations included limited cover gas pressure releases for maintenance purposes and characterization of potential emissions from a suspect waste tank and fume hood. Characterization of these ancillary emissions for CY 1998 reporting purposes relied on active sampling and conservative industry standard release calculation methodologies.

The Fuel Conditioning Facility (FCF) conducted operations in CY 1998 with EBR-II spent nuclear fuel. The facility is constantly ventilated. The ventilation stream of FCF is filtered and combined with the filtered and previously monitored EBR-II ventilation stream. These combined streams are collectively continuously monitored for all potentially-present radiological emissions. The continuous monitoring is supplemented with sampling and analysis for particulates, radioiodines, and typically gaseous radionuclides. Emissions from FCF during CY 1998 are reported herein.

The Hot Fuel Examination Facility (HFEF), completed and operating since 1975, houses two large shielded hot cells, one each with air and inert atmospheres. Currently, HFEF examination capabilities are being used to characterize mixed wastes within the DOE complex. HFEF emissions are filtered and continuously monitored for all types of potential radiological emissions. The continuous monitoring is supplemented with continuous sampling and subsequent analysis for particulates and radioiodines (both of which typically yield collections below detection limits) and monthly hot cell grab sampling for typically gaseous radionuclides. Particulate emissions from HFEF during CY 1998 are reported herein. Longer-lived gaseous fission product Kr-85 exists in the HFEF inert atmosphere cell and is released in minor amounts as a result of keeping the inert atmosphere cell at a negative pressure. Finally, the small quantity of activation product Ar-41 released from HFEF during CY 1998 is also reported herein.

The Fuel Manufacturing Facility (FMF) began operation in 1986 as a specialized facility built to cast uranium based fuel for the DOE-complex sodium cooled reactors. Since the shutdown of the EBR-II reactor, FMF has been employed in casting operations in support of waste form development activities as well as Highly Enriched Uranium (HEU) recovery operations. Spent fuel treatment technologies will also be tested at FMF as part of the ongoing ANL-W mission. The FMF is constantly ventilated with its emissions being sampled and analyzed for particulate characterization, the CY 1998 results of which are reported herein.

The Transient Reactor Test Facility (TREAT) reactor did not operate in CY 1998. The building ventilation system was operated only a few hours a month to keep the fan bearings lubricated. The bench-scale Plasma Hearth Process (PHP) was shut down and will probably not be restarted. The ventilation system is sampled and analyzed for particulates whenever the fans are operated. The particulate results reported during CY 1998 are from those few hours of operation each month of the building ventilation system for equipment maintenance purposes.

The Laboratory and Office Building (L&O) houses the majority of ANL-W's chemical and radiological analytical capabilities. The main hot cell, which vents through the L&O main stack, was completed in 1964 and is equipped to conduct destructive assays of irradiated fuel and therefore serves as a potential point of release for particulate and longer-lived gaseous fission products. The L&O main stack is actively monitored and sampled for particulate characterization. A monthly check is also made for Kr-85 release. The nondestructive assay (NDA) wing of the L&O Building was completed in 1976. Only particulate matter has the potential of being in the NDA ventilation stream, which is filtered and sampled for particulate characterization. The CY 1998 sampling results from both stacks are reported herein.

The Zero Power Physics Reactor (ZPPR) did not operate in CY 1998. Though the reactor is not operating, the building is actively ventilated to minimize the buildup of naturally occurring Rn-222 progeny in the facility, which results from Rn-222 diffusion into the facility from outside soil. The ZPPR facility is also the site of electron microscope analyses and other research activities. The ventilation stream is still actively sampled and analyzed for particulate matter, the results of which are reported herein.

The Fuel Assembly and Storage Building (FASB) has been in use since 1972 as a multipurpose facility housing a variety of operations including storage of reactor hardware and blanket subassemblies, assembly of blanket elements and jackets, metallurgical laboratory operations including welding, electron microscope analyses, and special sample preparations involving both irradiated and nonirradiated materials. Spent fuel and waste treatment research are part of the FASB future plans. The FASB is constantly ventilated with its emissions being sampled and analyzed for particulates, the CY 1998 results of which are reported herein.

The Sodium Components Maintenance Shop (SCMS), which began operations in 1977 as a facility for cleansing sodium-laden parts taken from the EBR-II reactor for repair or replacement purposes, continued cleansing operations in CY 1998. Emissions from the washing process are sampled and analyzed for particulates with the results reported herein. A series of support tanks containing recycled contaminated ethanol used in the SCMS wash process are not expected to have releases. However, ANL-W very conservatively applies industry standard tank flow through analysis methodologies along with periodic ethanol grab sample analyses to determine worst-case potential emissions from the support tanks.

The Radioactive Liquid Waste Treatment Facility (RLWTF), which began operation in 1982, received and processed 7,746 gallons of aqueous waste from other ANL-W facilities in CY 1998. All emissions were sampled and analyzed for particulates, the results of which are reported herein. All tritium emissions were characterized by liquid batch sampling with the presumption of 100% release in the form of tritiated water vapor.

Central Facilities Area

The CFA is located in the south-central section of the INEEL and provides support services for the INEEL. This area includes: (a) DOE Radiological and Environmental Sciences Laboratory (RESL), (b) Environmental Science and Research Foundation (Foundation), (c) maintenance shops, (d) vehicle maintenance facilities, (e) environmental monitoring and calibration laboratories, (f) communications and security systems, (g) fire protection, (h) medical services, (i) warehouses, and (j) other support services facilities. With the exception of RESL and the Foundation, CFA is operated for DOE-ID by LMITCO.

Minor releases occur from facilities at CFA where work is routinely conducted with small quantities of radioactive materials. This includes operations at RESL and the Environmental Chemistry Laboratory. RESL provides analytical services for environmental sampling programs. The Environmental Chemistry Laboratory provides analytical and bioassay services. Only small (tracer) quantities of radioactive materials are used at these facilities.

Idaho Nuclear Technical and Engineering Center

The INTEC is located in the south-central portion of the INEEL. The facility was constructed in 1950 and is operated under DOE-ID administration by LMITCO. The INTEC is a multipurpose plant containing approximately 230 buildings and structures.

The mission of the INTEC has changed significantly in light of the decision to discontinue reprocessing of spent nuclear fuel (SNF) in April 1992. Activities having radioactive emissions in 1998 at the INTEC are broken down into the following areas, which are discussed below:

- SNF Management

- Waste Management
- Technology Development.

<u>Spent Nuclear Fuel Management.</u> Before 1992, SNF was shipped to the INTEC for temporary storage before reprocessing for uranium recovery. Although fuel reprocessing was discontinued, DOE and Navy fuel continues to arrive for storage. This fuel is transferred to storage until final disposition (e.g., placement in a geologic repository) and conditioning needs and methods have been determined.

Fuel receipt and storage areas include the Fuel Storage Building (CPP-603), the Fluorinel and Storage (FAST) Facility (CPP-666), the Underground Fuel Storage Facility (CPP-749), and the Unirradiated Fuels Storage Facility (CPP-651). CPP-603 has fuel handling units (FHUs) stored in water pools or in the dry Irradiated Fuel Storage Facility; currently CPP-666 has only wet storage; CPP-749 has only dry storage; and CPP-651 has dry unirradiated fuel storage. All fuel elements are in retrievable storage. No new fuel is being received and transferred into CPP-603 underwater storage basins.

CY 1998 emissions for the FAST facility were based on the FAST Stack monitor. The remaining fuel storage facilities have a constant air monitor (CAM) that is used to determine air emissions, or air emissions are calculated based on process knowledge.

<u>Waste Management.</u> Interim storage space for high-level waste before calcination is provided by eleven 300,000-gal underground tanks (WM-180 to -190) and four 18,400-gal tanks (WL-101, WM-100, WM-101, and WM-102) housed in vaults at the north side of the Waste Disposal Building (CPP-604). WM-190 is the designated reserve tank if the other tanks leak. Additional storage can be provided by four 30,000-gal underground tanks (WM-103 to -106) that rest on concrete pads with curbing. These tanks are kept empty and are used only by special DOE authorizations for segregation of wastes from nonroutine campaigns. Emissions from these tanks are monitored via the Main Stack (CPP 708-001).

Calcination activities at the INTEC resumed in 1998. In the calcining process, radioactive liquid mixed with calcium nitrate and sometimes aluminum nitrate is sprayed continuously into a fluidized bed calcining vessel, where the droplets contact hot solid particles. Water evaporates while acids and other compounds decompose. Dissolved solids (i.e., metals and salts) are thus converted to dry, granular, calcined particles. This calcine is stored in stainless-steel bins contained in concrete vaults. Radiological air emissions from the first three bin sets are monitored via the Main Stack (CPP 708-001). Radiological air emissions from the remaining bin sets are negligible and are based on CAM data. Particulate emissions from the calcining off-gas are continuously monitored through the Main Stack per 40 CFR 61 requirements. Emissions from the New Waste Calcining Facility processing cells are continuously compliance monitored on the CPP-659 HVAC stack (CPP-659-33).

Low-level radioactive liquid wastes are collected and concentrated in the High-Level Liquid Waste Evaporator (HLLWE). The concentrate (e.g., bottoms) is then processed as high-level (sodium-bearing) radioactive waste. The overhead products from the HLLWE are processed through the Process Equipment Waste (PEW) Evaporator (CPP-604). The concentrate is processed as a high-level radioactive waste. The PEW overheads are processed through the Liquid Effluent Treatment and Disposal (LET&D) Facility where emissions are accounted for via the INTEC Main Stack.

Minor sources of radioactive emissions from waste management activities may include the radiological and hazardous waste accumulation area (CPP-1617), unloading and transfer of low-level radioactive liquids from CPP-1619, the Anti-C/Safety Equipment Handling Facility, and small, miscellaneous emissions from radioactively contaminated buildings and liquids in tanks.

Technology Development. LMITCO technology development efforts support the objectives of safe and efficient interim storage of SNF and radioactive waste, as well as the development of a process or processes to ultimately prepare SNF and radioactive wastes for final disposal.

Most radioactive emissions from these activities are from laboratories and pilot plants in the CPP-602, CPP-627, CPP-637, and CPP-684 buildings. The largest emission among these facilities is from the Remote Analytical Laboratory (RAL), CPP-684.

Power Burst Facility Area

The PBF area is located in the south-central portion of the INEEL. This area was originally used to support studies of nuclear reactors under normal and off-normal operating conditions. These studies were concluded in 1985 and the PBF area facilities have been modified to accommodate new missions or are no longer in use. The PBF area is operated for the DOE-ID by LMITCO.

The only potential sources of radioactive emissions in the PBF area are the PBF reactor and the Waste Experimental Reduction Facility (WERF), and the Mixed Waste Storage Repackaging Booth. The PBF reactor is currently in a shutdown mode.

The WERF is an experimental facility for research and development of techniques for handling and reducing the volume of radioactive and mixed wastes. Operations at the WERF include metal sizing, compaction, incineration, and stabilization of radioactively contaminated wastes.

Emissions from the PBF area result from WERF operations and periodic maintenance activities at PBF, i.e., cleanup and decontamination activities. Emissions from WERF are extremely small and result from the processing of waste contaminated with fission and activation products. Emissions from the North and East Stacks, which ventilate the incineration and waste handling activities, are continuously monitored. Air emission data for CY 1998 from the PBF area are provided in Section II.

Radioactive Waste Management Complex

The RWMC was established in the southwest corner of the INEEL in 1952 to accommodate the radioactive wastes generated by the INEEL operations. In addition to receipt of radioactive wastes generated at the INEEL, the RWMC has also received wastes from other DOE facilities including the Rocky Flats Plant. The RWMC is operated for the DOE-ID by LMITCO.

Areas at the RWMC include the Subsurface Disposal Area (SDA), the Transuranic Storage Area (TSA), the Operations Area and the administrative area. Low-level radioactive wastes are disposed in pits and vaults at the SDA. The TSA includes the Stored Waste Examination Pilot Plant (SWEPP), the Drum Venting Facility (DVF) and the Waste Storage Facility (WSF). Transuranic wastes are stored on an interim basis at the TSA. At the SWEPP facility, transuranic wastes are examined by various nondestructive techniques. A health physics laboratory fume hood is located in the Operations Area. In addition, environmental restoration techniques are being investigated at the RWMC. Emissions from these sources are based on engineering calculations derived from process knowledge with the exception of the DVF, which is based on a CAM.

Test Area North

The TAN complex is located at the north end of the INEEL. TAN has been used for a variety of projects and currently has two major facilities: SMC facility, and the Technical Support Facility (TSF) TAN Hot Shop. The TAN Hot Shop and the SMC facility are both operated for DOE-ID by LMITCO.

The TSF TAN Hot Shop contains decontamination and hot cell areas. Operations include decontamination of radioactively contaminated equipment and remote examination of radioactive materials.

The SMC Project is a multiphased manufacturing operation that produces an armor package for the U.S. Department of the Army. The SMC Project was assigned to the INEEL in mid-1983. Several existing facilities were modified and new facilities constructed to contain state-of-the-art manufacturing and processing equipment. The SMC Project consists of the Materials Development Facility (MDF), TAN-629 Fabrication and Assembly, TAN-679 Rolling Operation, and support facilities.

The MDF was established to support the identification, evaluation, and development of manufacturing processes for the SMC Project. Operations involve fabrication and assembly work to produce test-size armor assemblies. Standard metal working equipment such as punches, shears, brakes, and lasers are used to fabricate DU material. Other activities include development of tools and fixtures, and preparation and testing of metallurgical specimens.

The TAN-629 facility, located within the TAN hangar, contains production unit areas and space for offices, support functions, and service areas. TAN-675 is located on the north side of the hangar and houses utilities. TAN-677 is located on the south side for truck receiving and controlled access to the facility.

Production units are semiautomatic systems that perform the same types of operations as MDF, except on an automated basis to produce full-size assemblies at a higher throughput. The depleted uranium (DU) parts are sheared, punched, laser cut, cleaned, and painted. The assemblies are packaged and shipped to their final destination.

The TAN-679 facility consists of a manufacturing area and a Process Reclamation Facility (PRF), TAN-681. TAN-679 operations include a process production line, office area, support functions, and service areas. Depleted uranium (DU) material is processed and subsequently used as feedstock for TAN-629 operations. Processes include a preheat and hot roll operation, shearing to length and width, acid etching, water rinsing, and final inspection.

The PRF operations include the collection, recycling, and disposition of waste material. All contaminated liquid waste streams are collected in storage tanks for treatment/reuse.

Radiological air emissions from the TAN area are associated with the Hot Shop operations and the SMC. Potential emissions from the Hot Shop area include noble gases, iodines, and particulates. Emissions from this facility are operation specific and are not associated with any continuous process. Section II provides data on air emissions from the TAN Hot Shop area for CY 1998.

Radiological air emissions from SMC are associated with processing of DU. Potential emissions are uranium isotopes and associated radioactive progeny. Section II provides data on air emissions from the SMC for CY 1998.

Test Reactor Area

The TRA is located in the south-central section of the INEEL near the INTEC. Operations at TRA are conducted by LMITCO, under the administration of DOE-ID. The TRA Hot Cells, are operated by International Isotopes Idaho, Inc. under contract to LMITCO. The TRA has facilities for studying the performance of reactor materials and equipment components under high neutron flux conditions. The major facility at TRA is the Advanced Test

Reactor (ATR). Other operations at TRA include hot cell operations, research and development, site remediation, and analytical laboratory services.

Radioactive emissions from the TRA are primarily associated with operation of the ATR. These emissions include noble gases, iodines, and other mixed fission and activation products. Other radioactive emissions are associated with hot cell operations, sample analysis, site remediation, and research and development activities. Air emission data for TRA are provided in Section II.

II. AIR EMISSIONS DATA

As discussed in Section I, the INEEL contains a number of operations that have the potential to emit radionuclides. Tables II-1 through II-7 identify all stacks and vents at the INEEL that represent potential radiological air emission sources. Data on NRF emission sources are provided in Appendix A. The tables are organized according to the major INEEL operational areas described in Section I. The tables describe each potential emission point and the effluent controls and their efficiencies, if applicable. The tables also identify emission sources that require monitoring and/or sampling on a continuous basis.

The nearest receptor to the operational area is listed at the top of each table. Information on the INEEL maximally exposed individual (MEI), as well as location from these operational areas to the INEEL MEI, can be found in Section III. Not all potential radionuclide emission points are monitored on a continuous basis at INEEL. Section 61.93(b) of 40 CFR 61, Subpart H, provides prescriptive requirements for continuous monitoring of those emission points that have a potential to emit radionuclides in quantities that could result in an EDE to a member of the public in excess of 1% of the NESHAPs' dose standard of 10 mrem (1.0E-04 Sievert) per year, i.e., 0.1 mrem (1.0E-06 Sievert) per year. In evaluating the potential of a release point to discharge radionuclides into the air for the purposes of this regulation, the estimated radionuclide release rates are based on the discharge of the effluent stream that would result if all pollution control equipment did not exist but the facility operations were otherwise normal [40 CFR 61.93(b)(4)(ii)]. All other potential emission sources require periodic confirmatory measurements to verify the low emissions.

In response to NESHAPs' requirements, the INEEL conducted a study to determine radiological emission points subject to the 40 CFR 61.93(b) monitoring requirements. The methodology and results of the evaluation are presented in the report DOE/ID-10310, *NESHAPs 40 CFR 61.93 Monitoring Requirements for Radiological Emission Sources at INEEL*, November 1990. A reassessment of all the INEEL emission sources was completed in 1992 at the request of Environmental Protection Agency (EPA) Region X. In addition, the INEEL has implemented a "periodic confirmatory measurements" program in response to these 40 CFR 61.93(b) requirements.

The above evaluations identified six emission points that require continuous monitoring under 40 CFR 61.93(b). The six sources are: INTEC Main Stack (CPP-708-001), New Waste Calcining Facility HVAC Stack (CPP-659-033) [Note: This source was redesignated as requiring continuous monitoring under 40 CFR 61.93(b) in 1997], WERF north stack (PER-755-001), WERF east stack (PER-765-001), HFEF main stack (ANL-785-018), and ANL-W 200-ft stack (ANL-764-001). All other potential emission points were determined to have potential EDEs of less than 0.1 mrem (1.0E-06 Sievert) per year (Actual emissions from these points are based on sampling and/or engineering calculations based on process knowledge).

Tables II-8 and II-9 list the point source radionuclide emissions for CY 1998 associated with each operational area at the INEEL. Table II-8 lists emissions from all continuous compliance monitored sources, and Table II-9 lists the estimated radionuclide emissions from all other point sources. Table II-10 lists the nonpoint source radionuclide emissions for CY 1998 at the INEEL.

In some cases, results shown in Table II-8 and Table II-9 are reported as gross alpha, gross beta, and gross beta/gamma. In these instances, these emissions were assumed to be plutonium-239 for gross alpha and strontium-90 in equilibrium with yttrium-90 for gross beta and gross beta/gamma. This conservative assumption was based on the fact that these two radionuclides have extremely low concentration values in Table 2 of 40 CFR 61, Appendix E. However, it is not expected that these isotopes are always present due to the nature of the varying operations at these INEEL facilities.

Table II-1. ANL-W Radiological Air Emission Sources That Had Emissions In CY 1998

AREA	BLDG	VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[a]	CONTINUOUSLY MONITORED[b]
ARGONNE NATIONAL LABORATORY-WEST (ANL-W) Nearest Receptor - 8,679 m SSE						
ANL	704	008	FUEL MANUFACTURING FACILITY (FMF) MAIN STACK	CASTING AREA - TWO HEPA FILTER BANKS IN SERIES GLOVE BOX AREA - TWO HEPA FILTER BANKS IN SERIES REMAINDER - HEPA FILTER BANK	99.97% EACH	
ANL	752	004	MAIN LABORATORY AND OFFICE (L&O) BUILDING STACK	TWO HEPA FILTER BANKS IN SERIES	99.97% EACH	
ANL	752	005	NONDESTRUCTIVE ASSAY LABORATORY STACK IN THE LABORATORY AND OFFICE (L&O) BUILDING	EFL AREA - TWO HEPA FILTER BANKS IN SERIES REMAINDER - HEPA FILTER BANK	99.97% EACH	
ANL	764	001	FCF AND EBR-II REACTOR EMISSIONS EXHAUST THROUGH THIS 200-FOOT MAIN STACK	EBR- II – HEPA FILTER BANK FCF HOT CELL - TWO HEPA FILTER BANKS IN SERIES REMAINDER OF FCF - HEPA FILTER BANK	99.97% EACH	X
ANL	766	056	SECONDARY ARGON COVER GAS PURGE VENT	NONE	NONE	
ANL	768	105	SUSPECT WASTE TANK FROM DECONTAMINATION SHOWER IN HEALTH PHYSICS AREA OF POWER PLANT	HEPA FILTER BANK	99.97%	
ANL	768	108	HP AREA FUMEHOOD IN POWER PLANT	HEPA FILTER BANK	99.97%	
ANL	777	002	ZPPR	REACTOR CELL - TWO HEPA FILTER BANKS IN SERIES REMAINDER - HEPA FILTER BANK	99.97% EACH	
ANL	785	018	HOT FUEL EXAMINATION FACILITY (HFEF) MAIN STACK[c]	HOT CELLS - TWO HEPA FILTER BANKS IN ERIES REMAINDER - HEPA FILTER BANK	99.97% EACH	X
ANL	787	001	FUEL ASSEMBLY AND STORAGE BUILDING (FASB) MAIN STACK	HEPA FILTER BANK	99.97%	
ANL	793	001	SODIUM COMPONENTS MAINTENANCE SHOP (SCMS) MAIN STACK[d]	HEPA FILTER BANK	99.97%	
ANL	793A	025, 027, 029, 031, 033, 035	ALCOHOL STORAGE TANK VENTS	NONE	NONE	
ANL	798	017	RADIOACTIVE LIQUID WASTE EVAPORATOR EXHAUST	EVAPORATORS - TWO HEPA FILTER BANKS IN SERIES REMAINDER - HEPA FILTER BANK	99.97% EACH	
ARGONNE NATIONAL LABORATORY-WEST (ANL-W) TRANSIENT REACTOR TEST (TREAT) FACILITY						
ANL	720	007	TRANSIENT REACTOR TEST FACILITY REACTOR COOLING AIR EXHAUST	TWO BANKS HEPA FILTERS IN SERIES	99.97% EACH	

Table II-1. ANL-W Radiological Air Emission Sources That Had Emissions In CY 1998

a. A single HEPA filter will remove 99.97% of particulates that are 0.3 microns in diameter.
b. Air emission sources that require continuous monitoring are based on an unabated emission potential of 0.1 mrem/yr or greater.
c. Three exhaust systems contribute to this source:
   (1) Building-Laboratory exhaust system passes through one bank of dioctyl phthalate (DOP)-tested HEPA filters; 42,875 cfm.
   (2) Main Cell exhaust flows through three banks of HEPA filters, only one bank of which is DOP-tested; 0-500 cfm.
   (3) Decon Cell exhaust flows through three stages of HEPA filters, two stages of which are DOP-tested; 3030-3660 cfm.
d. Three ventilation systems contribute to the SCMS main stack exhaust:
   (1) Water Wash vessel exhaust flows through one stage of DOP-tested HEPA filters.
   (2) High Bay ventilation is also filtered by a single DOP-tested HEPA filter bank.
   (3) Process ventilation is double (DOP-tested) HEPA filtered.

Table II-2. CFA Radiological Air Emission Sources

CENTRAL FACILITIES AREA (CFA)				Nearest Receptor - 14,487 m SE		
AREA	BLDG	VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[a]	CONTINUOUSLY MONITORED[b]
CFA	625	010	VENTS LABORATORY HOODS IN WHICH RADIOLOGICAL SAMPLES ARE PREPARED FOR CHEMICAL ANALYSIS	HEPA FILTER BANK CONSISTINGOF NINE FILTERS WITH PRE-ILTERS	99.97%	
CFA	690	001	RADIOLOGICAL AND ENVIRONMENTAL SCIENCES LABORATORY (RESL)	NONE	NONE	
CFA	690	002	RESL	NONE	NONE	
CFA	690	003	RESL	NONE	NONE	
CFA	690	004	RESL	NONE	NONE	
CFA	690	005	RESL	NONE	NONE	
CFA	690	006	RESL	NONE	NONE	
CFA	690	007	RESL	NONE	NONE	
CFA	690	008	RESL	NONE	NONE	
CFA	690	009	RESL	NONE	NONE	
CFA	690	010	RESL	NONE	NONE	
CFA	690	015	RESL	NONE	NONE	
CFA	690	042	RESL	NONE	NONE	
CFA	690	045	RESL	NONE	NONE	
CFA	690	047	RESL	NONE	NONE	
CFA	690	049	RESL	NONE	NONE	
CFA	690	059	RESL	NONE	NONE	

a. A single HEPA filter will remove 99.97% of particulates that are 0.3 microns in diameter.

b. Air emission sources that require continuous monitoring are based on an unabated emission potential of 0.1 mrem/yr or greater.

Table II-3. INTEC Radiological Air Emission Sources

IDAHO NUCLEAR TECHNICAL AND ENGINEERING CENTER (INTEC)				Nearest Receptor - 17,143 m SSE		
AREA	BLDG	VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[a]	CONTINUOUSLY MONITORED[b]
CPP	601	024	HEXONE STORAGE AND FEED TANKS	NONE	NONE	
CPP	602	012	MAIN LAB EXHAUST FROM LABORATORY HOODS, GLOVE BOXES AND DENITRATOR IN BUILDING 602	HEPA FILTER OR TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	602	014	LABORATORY 224 CAVE IN 602	HEPA FILTER	99.97%	
CPP	602	031	PERCHLORIC ACID HOOD EXHAUST IN 602	DEMISTER	NONE	
CPP	603	001	IFSF	HEPA FILTER	99.97%	
CPP	603	019	UNDERWATER FUEL STORAGE AREA	NONE	NONE	
CPP	627	007	VENTS LABORATORY HOODS AND RADIOACTIVE GLOVE BOXES (SPECIAL ANALYSIS LAB, ACID FUME HOODS)	HEPA FILTER OR TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	627	008	SPECIAL ANALYSIS LABORATORY HOODS, EMISSIONS SPECTROSCOPY CAVE	TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	627	010	MULTICURIE CELL	HEPA FILTER	99.97%	
CPP	627	013	HOT CHEMISTRY LAB HOODS, GLOVE BOXES – DECON DEVELOPMENT LAB	HEPA FILTER	99.97%	
CPP	627	016	LABORATORY AIR SAMPLING SYSTEM USED FOR WET CHEMISTRY OF RADIOACTIVE SAMPLES – FASS	HEPA FILTER	99.97%	
CPP	630	011	LABORATORY HOODS AND OTHER EXHAUSTS FROM LABS IN 630	TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	630	012	LABORATORY HOODS AND EXHAUSTS FROM PART OF BUILDING 602 - 300 LABORATORIES	TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	637	010	MAIN EXHAUST FOR ALL FUME HOODS IN LABORATORY SECTION OF BUILDING (7 LABS, 22 HOODS)	HEPA FILTER OR TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	648	002	VENT FOR THE SLUDGE STORAGE TANK (VES-SFE-106)	HEPA FILTER (NOT TESTED)	99.97%	
CPP	659	033	EXHAUSTS BUILDING VENTILATION AIR FROM THE CALCINER AREA. DEBRIS TREATMENT FACILITY CONSISTING OF DECONTAMINATION OPERATIONS.	TWO HEPA FILTERS IN SERIES	99.97% each filter	X
CPP	659	036	EXHAUSTS BUILDING VENTILATION AIR FROM THE DECONTAMINATION AREA	TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	663	002	663 HOT SHOP EXHAUST	HEPA FILTER	99.97%	
CPP	684	001	REMOTE ANALYTICAL LABORATORY (RAL)	TWO HEPA FILTERS IN SERIES	99.97% each filter	

Table II-3. INTEC Radiological Air Emission Sources

IDAHO NUCLEAR TECHNICAL AND ENGINEERING CENTER (INTEC)				Nearest Receptor - 17,143 m SSE		
AREA	BLDG	VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[a]	CONTINUOUSLY MONITORED[b]
CPP	694	007	TANK VENTS FOR ORGANIC SOLVENT STORAGE TANK[c]	TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	694	008	TANK VENTS FOR ORGANIC SOLVENT STORAGE TANK[c]	TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	694	009	EXHAUST VENTILATION AIR FROM THE ORGANIC SOLVENT STORAGE TANK BUILDING[c]	HEPA FILTER (NOT TESTED)	99.97%	
CPP	694	010	TANK VENTS FOR ORGANIC SOLVENT STORAGE TANK[c]	TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	708	001	CPP MAIN STACK INCLUDING THE NEW WASTE CALCINING FACILITY	HEPA FILTER OR UP TO THREE HEPA FILTERS IN SERIES	99.97% each filter	X
CPP	732	001	BIN SET #1 – VENTS THE VAULT SURROUNDING THE STORAGE BINS (NOT FILTERED). VAULT AREA NO LONGER A SOURCE. STORAGE BINS SINGLE HEPA-FILTERED IN POG APS.	NONE (VAULT) HEPA FILTER (BINS)	99.97%	
CPP	742	001	BIN SET #2 – VENTS THE VAULT SURROUNDING THE STORAGE BINS (NOT FILTERED). VAULT AREA NO LONGER A SOURCE. STORAGE BINS SINGLE HEPA-FILTERED IN POG APS.	NONE (VAULT) HEPA FILTER (BINS)	99.97%	
CPP	746	001	BIN SET #3 – VENTS THE VAULT SURROUNDING THE STORAGE BINS (NOT FILTERED). VAULT AREA NO LONGER A SOURCE. STORAGE BINS SINGLE HEPA-FILTERED IN POG APS.	NONE (VAULT) HEPA FILTER (BINS)	99.97%	
CPP	748	001	VENT FOR TANK CONTANIING SLUDGE AND ASSOCIATED TANK VAULT	NONE	NONE	
CPP	749	001	SPENT FUEL STORAGE VAULKTS	HEPA FILTER ((NOT TESTED)	99.97%	
CPP	760	002	BIN SET #4 – VENTS THE VAULT SURROUNDING THE STORAGE BINS (NOT HEPA-FILTERED) AND THE STORAGE BINS (TWO HEPA FILTERS INSTALLED BUT NOT TESTED)	NONE (VAULT) TWO HEPA FILTERS IN SERIES INSTALLED BUT NOT TESTED	NONE	
CPP	764	002	VENT FOR VAULT CONTAINING HOT WASTE TANK (VES-SFE-126)	HEPA FILTER (NOT TESTED)	99.97%	
CPP	767	001	FAST STACK. VENTS THE FLUORINEEL AND STORAGE (FAST) FACILITY.	HEPA FILTER OR TWO HEPA FILTERS IN SERIES	99.97% each filter	

Table II-3. INTEC Radiological Air Emission Sources

IDAHO NUCLEAR TECHNICAL AND ENGINEERING CENTER (INTEC)					Nearest Receptor - 17,143 m SSE	
AREA	BLDG	VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[a]	CONTINUOUSLY MONITORED[b]
CPP	791	004	BIN SET #6 – VENTS THE VAULT SURROUNDING THE STORAGE BINS AND THE STORAGE BINS	NONE (VAULT) TWO HEPA FILTERS IN SERIES (BINS)	 99.97% each filter	
CPP	795	004	BIN SET #7 – INACTIVE	INACTIVE		
CPP	1608	001	MANIPULATOR REPAIR CELL	TWO HEPA FILTERS IN SERIES	99.97% each filter	
CPP	1611	AREA 1	PERCOLATION POND 2 (NONPOINT SOURCE)	NONE	NONE	
CPP	1612	AREA 1	PERCOLATION POND 1 (NONPOINT SOURCE)	NONE	NONE	
CPP	1617	001	RADIOLOGICAL AND HAZARDOUS WASTE ACCUMULATION AREA	NONE	NONE	
CPP	1619	001	UNLOADING AND TRANSFER OF LOW-LEVEL RADIOACTIVE LIQUIDS[c]	HEPA FILTER	99.97% each filter	
CPP	1646	001	ANTI-C/SAFETY EQUIPMENT HANDLING FACILITY	TWO HEPA FILTERS IN SERIES	99.97% each filter	

a. A single HEPA filter will remove 99.97% of particulates that are 0.3 microns in diameter.
b. Air emission sources that require continuous monitoring are based on an unabated emission potential of 0.1 mrem/yr or greater.
c. Not a source term for 1998.

Table II-4. PBF Area Radiological Air Emission Sources

POWER BURST FACILITY (PBF) AREA			Nearest Receptor - 12,231 m SSE			
AREA	BLDG	VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[a]	CONTINUOUSLY MONITORED[b]
PER	613	021	REPACKAGING BOOTH IUSED TO REPACKAGE MIXED WASTE, CHARACTERIZE MIXED WASTE AND VERIFY WASTE CONTENTS	ONE BANK HEPA FILTERS	99.97%	
PER	620	016	PBF REACTOR MAIN STACK - REACTOR IS ON STANDBY	ONE BANK HEPA FILTERS ONE BANK SILVER ZEOLITE FILTER	99.97% each filter 98.5%	
PER	620	041	VENT FROM A DECONTAMINATION SINK - DECON ROOM	HEPA FILTER	99.97%	
PER	765[c]	001[c]	VENTS COMPACTOR AND NEW SIZING ROOM. WERF EXHAUST EAST STACK.	TWO BAG HOUSE FILTERS IN SERIES ONE HEPA FILTER BANK.	90% 99.97%	X
PER	755	001	WERF EXHAUST NORTH STACK	BAG HOUSE FILTER ONE HEPA FILTER BANK	90% 99.97%	X
PER	756	001	WERF EXHAUST SOUTH STACK	ONE BANK HEPA FILTERS	99.97%	

a. A single HEPA filter will remove 99.97% of particulates that are 0.3 microns in diameter.
b. Air emission sources that require continuous monitoring are based on an unabated emission potential of 0.1 mrem/yr or greater.
c. This emission source replaces PER-622-003.

Table II-5. RWMC Radiological Air Emission Sources

RADIOACTIVE WASTE MANAGEMENT COMPLEX (RWMC)			Nearest Receptor - 7,976 m SSW			
AREA	BLDG	VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[a]	CONTINUOUSLY MONITORED[b]
WMF	601	009	HP LABORATORY HOOD USED FOR ENVIRONMENTAL SAMPLE PREPARATION FOR RADIOLOGICAL ANALYSIS	ONE 24 x 24-INCH HEPA FILTER	99.97%	
WMF	615	001	DRUM VENTING FACILITY STACK & HEAD SPACE GAS SAMPLING AND CONTROL SYSTEM	ONE INLINE HEPA FILTER TO STACK ONE HEPA FILTER IN SERIES WITH A BANK (THREE) OF ADSORBERS	99.97% each filter	
WMF			WASTE CHARACTERIZATION AND SEGREGATION TENT	HEPA FILTERED	99.97%	
WMF			OU 7-08 THREE VAPOR VACUUM EXTRACTION TREATMENT UNITS (MOBILE CERCLA UNITS)	NONE	NONE	

a. A single HEPA filter will remove 99.97% of particulates that are 0.3 microns in diameter.
b. Air emission sources that require continuous monitoring are based on an unabated emission potential of 0.1 mrem/yr or greater.

Table II-6. TAN Radiological Air Emission Sources

AREA	BLDG	VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[a]	CONTINUOUSLY MONITORED[b]
TEST AREA NORTH (TAN)				Nearest Receptor - 10,345 m E		
TAN	607	049	HOT SHOP CHANGE ROOM EXHAUST - ROOM EXHAUST FOR STEP-OFF PAD AREA FOR HOT SHOP. INSIDE OF VENT IS CONTAMINATED. THERE IS A POTENTIAL FOR RELEASE SIMILAR TO WHAT IS RELEASED FROM THE MAIN STACK. NOT IN OPERATION.	NONE	NONE	
TAN	666	001	VENT FOR TANKS USED FOR RECEIVING AND STORING LOW-LEVEL RADIOACTIVE LIQUID WASTES.	NONE	NONE	
TAN	726	001	RADIOACTIVE WATER STORAGE. VENTS FOR TANKS.	NONE	NONE	
TAN	734	001	MAIN EXHAUST STACK FOR THE TAN HOT CELL AND HOT CELL ANNEX AREA	ONE TO THREE HEPA FILTERS IN SERIES	99.97%	
TAN	607	136	EQUIPMENT DECONTAMINATION ROOM[c]	HEPA	99.97%	
TAN			OU 1-07B GROUNDWATER TREATMENT FACILITY	NONE	NONE	
TEST AREA NORTH (TAN) SMC FACILITIES				Nearest Receptor - 12,299 m E		
TAN	607	039	RESEARCH AND DEVELOPMENT PROCESS STACK (RAD STACK #1)	TWO HEPA FILTER BANKS	99.97%	
TAN	607	119	QUALITY CONTROL LAB (RAD STACK #2)	TWO HEPA FILTER BANKS	99.97%	
TAN	629	012	MANUFACTURING PROCESS (RAD STACK #5)	TWO HEPA FILTER BANKS	99.97%	
TAN	629	013	LINE 2A (RAD STACK #3) - MANUFACTURING PROCESS	TWO HEPA FILTER BANKS	99.97%	
TAN	629	014	MANUFACTURING PROCESS (RAD STACK #4)	TWO HEPA FILTER BANKS	99.97%	
TAN	679	022	NORTH PROCESS (RAD STACK #11) MANUFACTURING PROCESS (EF-206) AND INCLUDES EMISSIONS FROM THE QC LAB	TWO HEPA FILTER BANKS	99.97%	
TAN	679	023	NORTH PROCESS (RAD STACK #10) MANUFACTURING PROCESS (EF-205) AND INCLUDES EMISSIONS FROM THE QC LAB	TWO HEPA FILTER BANKS	99.97%	
TAN	679	024	NORTH PROCESS (RAD STACK #9) – MANUFACTURING PROCESS (EF-204) AND INCLUDES EMISSIONS FROM THE QC LAB	TWO HEPA FILTER BANKS	99.97%	
TAN	679	025	SOUTH PROCESS (RAD STACK #8) MANUFACTURING PROCESS (EF-203)	TWO HEPA FILTER BANKS	99.97%	
TAN	679	026	SOUTH PROCESS (RAD STACK #7) MANUFACTURING PROCESS (EF-202)	TWO HEPA FILTER BANKS	99.97%	
TAN	679	027	SOUTH PROCESS (RAD STACK #6) MANUFACTURING PROCESS (EF-201)	TWO HEPA FILTER BANKS	99.97%	
TAN	681	012	PROCESS RECLAMATION FACILITY FOR NITRIC ACID WITH SCRUBBER FOR NO_X AND HEPA FILTERS FOR RAD (EF-209) (RAD STACK #14)	TWO HEPA FILTER BANKS SCRUBBER	99.97% 50%	
TAN	681	018	PROCESS RECLAMATION FACILITY INCLUDING DRYER HOOD, CALCINER HOOD (RAD STACK #13)	TWO HEPA FILTER BANKS	99.97%	
TAN	681	020	PROCESS RECLAMATION FACILITY (RAD STACK #12)	TWO HEPA FILTER BANKS	99.97%	

a. A single HEPA filter will remove 99.97% of particulates that are 0.3 microns in diameter.
b. Air emission sources that require continuous monitoring are based on an unabated emission potential of 0.1 mrem/yr or greater.
c. Not a source term for 1998.

Table II-7. TRA Radiological Air Emission Sources

TEST REACTOR AREA (TRA)				Nearest Receptor - 19,172 m SSW		
AREA	BLDG	VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[a]	CONTINUOUSLY MONITORED[b]
TRA	604	035	TRA RADIOCHEMISTRY LABORATORY FUMEHOOD EXHAUST (661/604)	HEPA FILTER	99.97%	
TRA	604	072	PERCHLORIC ACID HOOD EXHAUST IN 604[c]	NONE	NONE	
TRA	604	073	PERCHLORIC ACID HOOD EXHAUST IN 604[c]	NONE	NONE	
TRA	604	074	PERCHLORIC ACID HOOD EXHAUST IN 604	NONE	NONE	
TRA	632	015	DECONTAMINATION ROOM EXHAUST HOOD (not used during 1998)[c]	HEPA FILTER	99.97%	
TRA	632	019	HOT CELL USED FOR DECONTAMINATION OPERATIONS, ASSEMBLING, DISASSEMBLING, OR DESTRUCTION OF RADIOACTIVE MATERIALS	HEPA FILTER	99.97%	
TRA	632	030	HOT CELL USED FOR DECONTAMINATION OPERATIONS, ASSEMBLING, DISASSEMBLING, OR DESTRUCTION OF RADIOACTIVE MATERIALS - ALSO METALLOGRAPHY	HEPA FILTER	99.97%	
TRA	632	041	HOT CELL USED FOR DECONTAMINATION OPERATIONS, ASSEMBLING, DISASSEMBLING, OR DESTRUCTION OF RADIOACTIVE MATERIALS	HEPA FILTER	99.97%	
TRA	660	004	FUMEHOOD[c]	HEPA FILTER	99.97%	
TRA	661	008	VENTS THE NEW RADIOCHEMISTRY WING EXTENSION (7 HOODS AND 2 STORE ROOMS)	HEPA FILTER	99.97%	
TRA	668	013	LABORATORY 98 FUMEHOOD EXHAUST[c]	NONE	NONE	
TRA	668	015	LABORATORY 100 FUMEHOOD EXHAUST[c]	NONE	NONE	
TRA	670	074	SAMPLE HOOD FOR PRIMARY AND SECONDARY COOLING WATER IN ADVANCED TEST REACTOR (ATR)	HEPA FILTER	99.97%	
TRA	670	086	LABORATORY 131 FUMEHOOD EXHAUST	HEPA FILTER	99.97%	
TRA	670	098	EXHAUST FROM TWO WET CHEMISTRY HOODS AND THE HEALTH PHYSICS OFFICE AT ATR	HEPA FILTER	99.97%	
TRA	710	001	MATERIAL TEST REACTOR (MTR) MAIN STACK (REACTOR SHUT DOWN). THE TRA TRITIUM LABORATORY, CATCH TANK VENT (FROM 604, 661, 632 AREAS), TRA-604/661 LAB HOT CELL VENT SCRUBBER, AND TRA-605 BUILDING EXHAUST VENT OUT THIS STACK.	TRA-604 - 661 HOT CELL VENT SCRUBBER IS VENTED THROUGH A HEPA FILTER. ALL OTHER SOURCES LISTED HAVE ONE HEPA FILTER AND NONRADIOACTIVE SOURCES HAVE NO EFFLUENT CONTROL.	99.97% each filter	
TRA	753	001	VENTILATION EXHAUST FROM ENGINEERING TEST REACTOR (ETR) BUILDING (SHUTDOWN)	NONE	NONE	
TRA	770	001	ATR MAIN STACK	NONE	NONE	

a. A single HEPA filter will remove 99.97% of particulates that are 0.3 microns in diameter.
b. Air emission sources that require continuous monitoring are based on an unabated emission potential of 0.1 mrem/yr or greater.
c. Not a source term for 1998.

Table II-8. Point Source Radionuclides (Continuously Compliance Monitored Sources) From The INEEL Facilities During 1998

Radionuclide	1998 Annual Quantity (Ci)[a]					
	ANL-764-001	ANL-785-018	CPP-708-001	CPP-659-033	PER-755-001	PER-765-001[e]
Am-241				1.52E-11		
Am-243					3.93E-8	
Ar-41		2.25E+0				
C-14					2.73E-3[d]	
Co-60			6.60E-7			
Cs-134			2.21E-6			
Cs-137/Ba-137m			1.20E-3	2.08E-9		
Eu-154			5.81E-7			
Gross Alpha[b]	3.13E-5	4.05E-8				
Gross Beta/Gamma[c]	1.63E-6	5.39E-7				
H-3	2.98E+1		3.04E-5[d]		1.26E-2[d]	
I-129			3.63E-3[d]		9.03E-11[d]	
Kr-85	4.67E+3	1.23E+1				
Pu-238			4.97E-6			
Pu-239			4.57E-7	5.51E-11	5.55E-9	
Pu-240						
Ru-106/Rh-106			4.11E-5			
Sb-125/Te-125m			1.01E-5			
Sr-90/Y-90			3.09E-4			
Th-228					1.89E-9	
Th-230					7.32E-9	
Th-232					2.22E-9	
U-233					1.11E-9	
U-234					7.03E-9	
U-235						
U-238					7.32E-9	
Xe-131M	2.77E-13					

Table II-8. Point Source Radionuclides (Continuously Compliance Monitored Sources) From The INEEL Facilities During 1998

a. 1 Curie is equal to 37 Giga Becquerel
b. Assumed to be Pu-239
c. Assumed to be Sr-90/Y-90.
d. Emissions conservatively estimated based on engineering calculations; these specific nuclides do not constitute >10% of the potential effective dose equivalent.
e. No emissions reported for Stack 765 in 1998

Table II-9. Point Source Radionuclides (All Other Release Points) From The INEEL Facilities During 1998

	Actual/Estimated Release (Ci)[a]							
	ANL-W	CFA	INTEC	NRF	PBF	RWMC	TAN/SMC	TRA
Ac-227					2.9E-14			
Ag-110m					3.7E-11			
Am-241		6.2E-11	7.2E-7		1.1E-11	2.4E-7		2.2E-11
Am-243		1.1E-10			2.0E-8			1.0E-10
Ar-41								1.2E+3
Ba-139								1.4E-5
Ba-140								2.1E-6
C-14				8.1E-1	2.7E-9	1.6E-7		7.3E-8
Cd-113m[d]					3.6E-15			
Ce-141								1.2E-10
Ce-144			2.1E-10		6.8E-13			
Cm242					4.4E-14			
Cm-243					9.4E-13			
Cm-244					1.3E-12	2.0E-9		
Cm-246					7.0E-13			
Co-57					3.3E-13			
Co-58					1.2E-10			3.96E-7
Co-60			5.1E-7		1.2E-8			8.6E-5
Cr-51								3.7E-3
Cs-134			2.0E-8		3.7E-11			9.9E-6
Cs-137/Ba-137m		1.3E-9	5.7E-4		9.5E-9	4.2E-8	2.0E-10	1.4E-5
Cs-138								5.0E-2
Eu-152			9.6E-6		5.6E-14			1.8E-7
Eu-154			4.9E-6		5.7E-11			4.4E-7
Eu-155			3.6E-11		3.4E-12			2.3E-7
Fe-55					4.5E-9			7.8E-5
Fe-59					4.7E-13			3.1E-9
Gd-153[d]								2.1E-7
Gross Alpha[b]	7.64E-8						7.5E-8	
Gross Beta[c]							2.9E-7	
Gross Beta/Gamma[c]	1.61E-5							
H-3	1.26E-2		1.2E-8	4.9E-2	1.4E-8	3.7E-2	1.8E-4	1.7E+2
Hf-181					1.0E-13			2.7E-11
Hg-203				7.6E-8				4.3E-5
I-128[d]								1.4E-12
I-129			1.8E-9		1.2E-17			
I-131								6.6E-4
I-132								2.9E-12
I-133								1.5E-3
I-135								8.4E-2
Ir-192								3.1E-2
K-40					4.2E-12			
Kr-85				3.0E-1	1.1E-12			
Kr-85m								1.5E+0
Kr-88								1.1E+0
Mn-54					8.4E-11			1.5E-11
Mn-56								4.5E-4

Table II-9. Point Source Radionuclides (All Other Release Points) From The INEEL Facilities During 1998

	Actual/Estimated Release (Ci)[a]							
	ANL-W	CFA	INTEC	NRF	PBF	RWMC	TAN/SMC	TRA
Na-24								1.3E-2
Nb-94					5.3E-11			1.4E-11
Nb-95					5.3E-12			1.45E-11
Ni-63					6.7E-8			5.4E-6
Np-237			3.7E-13		2.8E-13			7.3E-13
Np-239								3.7E-10
P-32								1.9E-11
Pa-231					4.1E-14			
Pa-233					9.3E-14			
Pa-234/Pa-234m			1.7E-7		5.0E-10		6.2E-7	
Pm-147					4.5E-11			1.6E-8
Po-212					1.8E-12			
Pr-144			1.8E-10					
Pu-238		6.7E-11	7.8E-8		1.7E-11	1.6E-7		2.4E-8
Pu-239		1.3E-11	4.4E-5	5.4E-6	5.4E-12	1.1E-7		1.1E-6
Pu-240					5.3E-12	2.6E-8		
Pu-241					1.3E-11	4.3E-7		
Pu-242		1.6E-10			1.2E-17			
Rb-88								1.1E+0
Re-186[d]								5.9E-10
Re-188[d]								3.3E-4
Ru-103								4.7E-12
Ru-106/Rh-106			3.6E-11		9.5E-13			2.4E-13
Sb-122[d]								3.5E-9
Sb-124					2.2E-13			2.9E-12
Sb-125/Te-125m			1.2E-4		2.2E-13			1.4E-13
Sm-151					6.0E-12			1.8E-8
Sn-113					5.3E-13			
Sr-85[d]		1.8E-7						4.0E-9
Sr-89								2.3E-7
Sr-90/Y-90			5.9E-4	8.7E-5	4.2E-8	5.6E-13		5.7E-4
Tc-99			6.9E-11					
Tc-99m								1.4E-3
Th-229		1.1E-10			3.9E-12			
Th-230								5.5E-10
Th-231			5.6E-12		5.0E-11			
Th-232					8.5E-11			
Th-234			1.7E-7		8.8E-10		6.2E-7	
U-232		1.1E-10						
U-233			4.2E-8		2.1E-9	2.0E-9		
U-234		5.4E-11	8.9E-7		1.2E-9		6.6E-8	5.2E-9
U-235			1.1E-8		5.4E-11			
U-236			1.6E-9		4.2E-12			
U-238		4.9E-11	1.7E-7		5.8E-9		6.2E-7	4.5E-10
W-187								3.0E-4
Xe-133								7.8E+0
Xe-135								1.9E+1

Table II-9.Point Source Radionuclides (All Other Release Points) From The INEEL Facilities During 1998

	Actual/Estimated Release (Ci)[a]							
	ANL-W	CFA	INTEC	NRF	PBF	RWMC	TAN/SMC	TRA
Xe-135m								1.3E-11
Xe-138								2.0E-1
Y-90m								1.31E-5
Y-91m								1.1E-4
Zn-65					5.9E-16			5.1E-9
Zr-95			3.0E-11		5.3E-12			1.5E-12

a. 1 Curie is equal to 37 Giga Becquerel.
b. Assumed to be Pu-239.
c. Assumed to be Sr-90/Y-90.
d. Radionuclide not in CAP-88 database, so dose is not modeled.

Table II-10. Non-Point Source Radionuclides (Diffuse Emission Sources) From The INEEL Facilities During 1998[a]

Source	Area	Met. Location	Concentration (pCi/g unless stated)	Inventory (Ci)	Release (Ci/y)
PBF					
ARA-I and II and SL-1	a. 5 acres (20,200 m²) (chemical evaporation pond). (This area was remediated in 1996)	PBF	Co-60	3.1E-2	9.7E-7
			Sr-90	8.1E-3	2.5E-7
			Cs-134	1.8E-2	5.6E-7
			Cs-137	4.8E-1	1.5E-5
	b. 111.4 acres (451,000 m²)		Co-60 0.2	1.8E-3	5.7E-8
			Cs-137 100	9.0E-1	2.8E-5
			Sr-90 20	1.8E-1	5.7E-6
	c. 98,200 ft² (9,100 m²) (This area was remediated in 1996)		Pu-238 0.025	4.6E-6	1.4E-10
Areas S.W. of ARA-II	15.6 acres (63,100 m²)	PBF	Co-60 0.2	2.5E-4	7.9E-9
			Sr-90 20	2.5E-2	7.9E-7
			Cs-137 100	0.13	4.1E-6
ARA-III Pond	562,000 ft² (52,200 m²)	PBF	Co-60 38	4.0E-2	1.3E-6
			Sr-90 0.3	3.1E-4	9.8E-9
			Cs-137 6	6.3E-3	2.0E-7
			Ag-108m 40	4.1E-2	1.3E-6
SPERT-IV Leach Pond	0.53 acres (2,145 m²) (The pond is no longer receiving liquid)	PBF	Co-60 2.29	9.8E-5	3.1E-9
			Sr-90 5.4	2.3E-4	7.3E-9
			Cs-137 12.5	5.4E-4	1.7E-8
			U-235 86	3.7E-3	1.2E-7
			Pu-239/40 0.14	6.0E-6	1.9E-10
			U-234 18	7.7E-4	2.4E-8
			U-235		1.2E-7
			U-238 4.5	1.9E-4	6.1E-9
PBF Reactor Canal		PBF	H-3 (100% Release)		1.8E-2
Total for PBF Area			H-3		1.8E-2
			Co-60		2.3E-6
			Sr-90		6.8E-6
			Ag-108m		1.3E-6
			Cs-134		5.6E-7
			Cs-137		4.7E-5
			U-235		1.2E-7
			Pu-238		1.4E-10
			Pu-239/40		1.9E-10
			U-234		2.4E-8
			U-235		1.2E-7
			U-238		6.1E-9
CFA					
Organic Moderated Reactor Experiment	1.84 acres (745 m²)	CFA	Co-60 43	6.4E-3	2.0E-7
			Sr-90 18	2.6E-3	8.2E-8
			Cs-137 63	9.3E-3	2.9E-7
CFA Sewage Plant Drain Field	5.3 acres (21,450 m²)	CFA	Co-60 127	5.4E-2	1.7E-6
			Sr-90 50	2.1E-2	6.6E-7
			Sb-125 2.1	9.0E-4	2.8E-8
			Cs-134 4	1.7E-3	5.4E-8
			Cs-137 600	0.25	7.9E-6
			Eu-152 3.6	1.5E-3	4.7E-8
			Eu-154 5	2.1E-3	6.6E-8
			Eu-155 1.6	6.9E-4	2.2E-8
			U-235 0.01	4.3E-6	1.4E-10

Table II-10. Non-Point Source Radionuclides (Diffuse Emission Sources) From The INEEL Facilities During 1998[a] (Continued)

Source	Area	Met. Location	Concentration (pCi/g unless stated)	Inventory (Ci)	Release (Ci/yr)
CFA Tritium to air from Misc. aquifer water use	1.0 acre (4,047 m^2) (conservative assumption)	CFA	H-3 (present in aquifer water pumped and used at CFA)	Na	3.5E+0
CFA Ditch and Pit	1.0 acre (4,047 m^2)	CFA	Co-60 26.4 Cs-134 0.9 Cs-137 2988.0 Eu-154 9.9	2.1E-3 7.3E-5 2.4E-1 8.0E-4	6.6E-8 2.3E-9 7.6E-6 2.5E-8
Total for CFA Area			H-3 Co-60 Sr-90 Sb-125 Cs-134 Cs-137 Eu-152 Eu-154 Eu-155 U-235		3.5E+0 2.0E-6 7.4E-7 2.8E-8 5.6E-8 1.6E-5 4.7E-8 9.1E-8 2.2E-8 1.4E-10
RWMC					
EBR-I	a. 2.2 acres (8,903 m^2) b. 2.2 acres (8,903 m^2)	CFA	Cs-137 108 Sr-90 2.9 Cs-137 2090 Sr-90 2.5	1.9E-2 5.2E-4 0.37 4.4E-4	6.0E-7 1.6E-8 1.2E-5 1.4E-8
BORAX-I	0.64 acres (2,590 m^2) (This site was remediated in 1996)	CFA	Cs-137 227 U-235 5.82	1.2E-2 3.0E-4	3.7E-7 9.5E-9
SDA Gaseous Releases from Buried Waste	Treat as a point source at Pit 17 (conservative)	CFA	H-3 C-14		9.2E+01 8.2E-2
Total for RWMC Area			H-3 C-14 Cs-137 Sr-90 U-235		9.2E+01 8.2E-2 1.4E-5 3.0E-8 9.5E-9

Table II-10. Non-Point Source Radionuclides (Diffuse Emission Sources) From The INEEL Facilities During 1998[a] (Continued)

Source	Area	Met. Location	Concentration (pCi/g unless stated)	Inventory (Ci)	Release (Ci/yr)
INTEC					
INTEC Percolation Pond (Dry)	4.47E+05 ft^2 (41,509 m^2)	GRD3	Am-241 0.15	7.0E-5	2.2E-9
			Sb-125 0.60	2.8E-4	8.8E-9
			Ce-144 0.63	2.9E-4	9.2E-9
			Cs-134 1.75	8.1E-4	2.6E-8
			Cs-137 46.8	2.2E-2	6.9E-7
			Co-60 0.31	1.4E-4	4.5E-9
			I-129 2.6	1.2E-3	3.8E-8
			Np-237 1.1	5.1E-4	1.6E-8
			Pu-238 0.9	4.2E-4	1.3E-8
			Pu-239 0.27	1.3E-4	4.0E-9
			[all Pu modeled as Pu-238]		[1.7E-8 total Pu]
			Ru-106 3.1		4.5E-8
			Rh-106 3.1	1.4E-3	4.5E-8
			Sr-90 0.65	1.4E-3	9.5E-9
			Y-90 0.65	3.0E-4	9.5E-9
			H-3 0.61	3.0E-4	8.9E-9
			[assume H-3 in dry area is a solid form]	2.8E-4	
			U-234 0.77		1.1E-8
			U-235 0.07	3.6E-4	1.0E-9
			U-238 0.82	3.3E-5	1.2E-8
			[all U modeled as U-234]	3.8E-4	[2.4E-8 total U]
Inside INTEC Fence	150 acres (6.07E+05 m^2)	GRD3	Cs-137 12.0	1.5E-1	4.6E-6
			Eu-152 3.0	3.6E-2	1.1E-6
			Nb-95 0.08	9.7E-4	3.1E-8
			Ru-106 0.07	8.5E-4	2.7E-8
			Rh-106 0.07	8.5E-4	2.7E-8
			Sb-125 0.6	7.3E-3	2.3E-7
Outside INTEC Fence	19.2 acres (77,700 m^2)	GRD3	Cs-137 46.1	7.2E-2	2.3E-6
Total for INTEC Area		GRD3	Am-241		2.2E-9
			Sb-125		2.4E-7
			Ce-144		9.2E-9
			Cs-134		2.6E-8
			Cs-137		7.6E-6
			Co-60		4.5E-9
			I-129		3.8E-8
			Np-237		1.6E-8
			Pu-238		1.3E-8
			Pu-239		4.0E-9
			[all Pu modeled as Pu-238]		[1.7E-8 total Pu]
			Ru-106		7.2E-8
			Rh-106		7.2E-8
			Sr-90		9.5E-9
			Y-90		9.5E-9
			H-3		8.9E-9
			U-234		1.1E-8
			U-235		1.0E-9
			U-238		1.2E-8
			[all U modeled as U-234]		[2.4E-8 total U]
			Nb-95		3.1E-8
			Eu-152		1.1E-6

Table II-10. Non-Point Source Radionuclides (Diffuse Emission Sources) From The INEEL Facilities During 1998[a] (Continued)

Source	Area	Met. Location	Concentration (pCi/g unless stated)	Inventory (Ci)	Release (Ci/y)
TRA					
TRA Sewage Plant Leach Ponds (dry areas)	32,500 ft^2 (3,019 m^2)	TRA	Co-60 327.0	2.0E-2	6.3E-7
			Ag-108m 6.5	3.8E-4	1.2E-8
			Cs-137 590.1	3.6E-2	1.1E-6
			Eu-152 5.9	3.6E-4	1.1E-8
			Eu-154 5.7	3.4E-4	1.1E-8
			Sr-90 1.4	8.5E-5	2.7E-9
			U-234 5.2	3.1E-4	9.8E-9
			U-238 1.9	1.1E-4	3.5E-9
			Pu-238 0.1	6.0E-6	1.9E-10
			Pu-239 0.5	3.0E-5	9.4E-10
			Am-241 2.6	1.6E-4	5.0E-9
TRA Warm Waste Evaporation Pond		TRA	H-3 (100% Release)	7.5E+1	7.5E+1
TRA Warm Waste Evaporation Pond (periodically wetted areas)		TRA	Ag-110m		2.7E-7
			Ba-131		4.5E-9
			Ba-140		3.2E-8
			Ce141		5.0E-7
			Ce-144		1.4E-6
			Co-58		9.4E-7
			Co-60		3.2E-4
			Cr-51		3.1E-4
			Cs-134		5.8E-7
			Cs-137		5.4E-5
			Cs-138		4.6E-5
			Eu-152		7.5E-8
			Eu-154		3.4E-8
			Eu-155		2.3E-9
			Fe-59		1.4E-7
			Gd-153		1.1E-7
			Hf-175		4.3E-7
			Hf-181		1.1E-5
			I-131 (100 % release)		5.4E-4
			I-133 (100 % release)		1.6E-4
			La-140		2.5E-8
			Mn-54		1.2E-6
			Mo-99		1.6E-8
			Na-24		5.4E-6
			Nb-95		1.7E-6
			Np-239		2.3E-8
			Re-188		6.8E-8
			Ru-103		1.8E-6
			Ru-105		3.8E-7
			Sb-122		2.0E-8
			Sb-124		4.4E-7
			Sb-125		6.8E-9
			Sb-127		1.1E-8
			Sc-46		2.2E-7
			Sr-89		2.6E-7
			Sr-90		5.7E-7
			Ta-182		4.6E-7
			ThTL-232		4.5E-9
			Xe-133 (100% release)		3.6E-4
			Y-90		5.7E-7
			Zn-65		3.1E-6

Table II-10. Non-Point Source Radionuclides (Diffuse Emission Sources) From The INEEL Facilities During 1998[a] (Continued)

Source	Area	Met. Location	Concentration (pCi/g unless stated)	Inventory (Ci)	Release (Ci/y)
			Zr-95		4.9E-6
TRA North Storage Area	a. 25,000 ft^2 (2,323 m^2) (These areas were remediated in 1996) b. 25,000 ft^2 (2,323 m^2)	TRA	Ag-108m		5.8E-9
			Co-60		3.4E-9
			Cs-137		5.3E-9
			Eu-152		1.1E-8
			Sr-90		1.4E-8
MTR Area	25,000 ft^2 (2,323 m^2)	TRA	Co-60 8460	0.39	1.2E-5
			Zn-65 39	1.8E-3	5.7E-8
			Cs-137 16	7.4E-4	2.4E-8
Total for TRA Area		TRA	Ag-108m		1.2E-8
			Ag-110m		2.7E-7
			Am-241		5.0E-9
			Ba-131		4.5E-9
			Ba-140		3.2E-8
			Ce141		5.0E-7
			Ce-144		1.4E-6
			Co-58		9.4E-7
			Co-60		3.4E-4
			Cr-51		3.1E-4
			Cs-134		5.8E-7
			Cs-137		5.4E-5
			Cs-138		4.6E-5
			Eu-152		9.7E-8
			Eu-154		4.5E-8
			Eu-155		2.3E-9
			Fe-59		1.4E-7
			Gd-153		1.1E-7
			H-3		7.5E+1
			Hf-175		4.3E-7
			Hf-181		1.1E-5
			I-131 (100 % release)		5.4E-4
			I-133 (100 % release)		1.6E-4
			La-140		2.5E-8
			Mn-54		1.2E-6
			Mo-99		1.6E-8
			Na-24		5.4E-6
			Nb-95		1.7E-6
			Np-239		2.3E-8
			Pu-238		1.9E-10
			Pu-239		9.4E-10
			Re-188		6.8E-8
			Ru-103		1.8E-6
			Ru-105		3.8E-7
			Sb-122		2.0E-8
			Sb-124		4.4E-7
			Sb-125		6.8E-9
			Sb-127		1.1E-8
			Sc-46		2.2E-7
			Sr-89		2.6E-7
			Sr-90		5.9E-7
			Ta-182		4.6E-7
			ThTL-232		4.5E-9
			U-234		9.8E-9
			U-238		3.5E-9
			Xe-133 (100% release)		3.6E-4

Table II-10. Non-Point Source Radionuclides (Diffuse Emission Sources) From The INEEL Facilities During 1998[a] (Continued)

Source	Area	Mat. Location	Concentration (pCi/g unless stated)	Inventory (Ci)	Release (Ci/y)
			Y-90 Zn-65 Zr-95		5.7E-7 3.2E-6 4.9E-6
TAN					
TAN TSF-06, removal of soil from areas 7,8,9,11a,11b	670 yd^3 (513 m^3)	TAN	Cs-137 100 Co-60 5 Eu-152 1 Sr-90 10		1.4E-5 7.0E-7 1.4E-7 1.4E-6
TAN TSF-26. PM-2A Tank site-soil removal	1,800 yd^3 (1,377 m^3)	TAN	Co-60 5 Cs-137 300		1.9E-6 1.1E-4
TAN Radioactive Parts Storage Security Area (RPSSA)	600,000 ft^2 (55,740 m^2)	TAN	Cs-137 56.5 Co-60 4.1 Sr-90 5.4 Pu-238 0.060 Pu-240 0.054 U-238 1.1 U-235 0.050 U-234 1.4	6.3E-2 4.6E-3 6.0E-3 6.7E-5 6.0E-5 1.2E-3 5.6E-5 1.6E-3	2.0E-6 1.4E-7 1.9E-7 2.1E-9 1.9E-9 3.8E-8 1.8E-9 5.0E-8
TAN V1, V2 and V3 Tank Area	5,500 ft^2 (511 m^2)	TAN	Cs-137 1.07E3 Co-60 38 Cs-134 0.9 Eu-154 1.3	1.1E-2 3.9E-4 9.2E-6 1.3E-5	3.5E-7 1.2E-8 2.9E-10 4.1E-10
TAN Disposal Pond - High Area	40,000 ft^2 (3,716 m^2)	TAN	Cs-137 48 Co-60 1.4	3.6E-3 1.0E-4	1.1E-7 3.2E-9
TAN Disposal Pond –Depressions	8,000 ft^2 (743 m^2)	TAN	Cs-137 3 Co-60 0.4	4.4E-5 6.0E-6	1.4E-9 1.9E-10
TAN Disposal Pond - Pond Bottom	80,000 ft^2 (7,432 m^2) Total Area 1.19E+4 m^2	TAN	Cs-137 46 Co-60 88 Total Cs-137 Total Co-60	6.8E-3 1.3E-2	2.1E-7 4.1E-7 3.2E-7 4.1E-7
TAN Warm Shop		TAN			0
TAN PREPP Area		TAN			0
TAN Hot Shop Annex		TAN			0
TAN Storage Pool		TAN	H-3 (100% Release)	5.9E-2	5.9E-2
TAN Groundwater Treatment Plant OU1-07		TAN	H-3		1.8E-4
Total for TAN Area			H-3 Cs-137 Co-60 Sr-90 Pu-238 Pu-240 U-238 U-235 U-234 Cs-134 Eu-152 Eu-154		5.9E-2 1.3E-4 3.2E-6 1.6E-6 2.1E-9 1.9E-9 3.8E-8 1.8E-9 5.0E-8 2.9E-10 1.4E-7 4.1E-10

a. Diffuse emission sources for NRF are included Appendix A.

III. DOSE ASSESSMENTS

Summary

Tables III-1 and III-2 summarize the 1998 INEEL emission points for continuously compliance monitored sources and all other point sources, respectively, and the EDE associated with each. Table III-3 summarizes the 1998 diffuse emission sources at the INEEL, and the EDE associated with each. 40 CFR 61, Subpart H, requires that "compliance with the standard be determined by calculating the highest effective dose equivalent to any member of the public at any offsite point where there is a residence, school, business or office." The EDE to the MEI calculated for emissions from continuously compliance monitored release points during 1998 is 1.88E-3 mrem (1.88E-8 Sievert). The EDE to the MEI for the remaining point sources is 3.28E-03 mrem (3.28E-08 Sievert). The diffuse source EDE to the MEI is 2.94E-03 mrem (2.94E-08 Sievert). These EDEs, when summed, result in a calculated 1998 total EDE to the MEI from the entire INEEL of 8.10E-03 mrem (8.10E-08 Sievert).

The following sections provide the methodology used to calculate radiological dose impacts, and the dose impacts associated with each INEEL operations area.

Table III-1. Summary Of 1998 Effective Dose Equivalents To The MEI From Continuously Compliance Monitored Release Points At The INEEL

		Release Point	EDE (mrem)[a]
ANL-W			
	1.	EBR-II and FCF (ANL-764-001)	4.26E-05
	2.	HFEF (ANL-785-018)[c]	1.58E-06
		TOTAL:	4.42E-05
CFA			
		CFA has no Continuous Compliance Monitored Sources	
INTEC			
	1.	INTEC Main Stack (CPP-708-001)[b]	1.83E-03
	2.	INTEC NWCF (CPP659-033)	3.90 E-10
		TOTAL:	1.83E-03
NRF			
		NRF has no Continuous Compliance Monitored Sources	
PBF			
	1.	WERF North (PER-755-001)[b, c]	2.54E-06
	2.	WERF East (PER-765-001)	0
		TOTAL:	2.54E-06
RWMC			
		RWMC has no Continuous Compliance Monitored Sources	
TAN			
		TAN has no Continuous Compliance Monitored Sources	
TRA			
		TRA has no Continuous Compliance Monitored Sources	
ALL FACILITIES			1.88E-03

a. The EDE shown is to the INEEL MEI.

b. Includes dose from unmonitored gaseous emissions.

c. Includes stack releases being modeled as ground-level releases due to building wake effects

Table III-2. Summary Of 1998 Effective Dose Equivalents From Other Release Points At The INEEL

		Release Point	EDE (mrem)[a]
ANL-W			
	1.	ANL-W Ground-level releases[b]	4.28E-07
		TOTAL:	4.28E-07
CFA			
	1.	RESL[b]	4.13E-08
		TOTAL:	4.13E-08
INTEC			
	1.	INTEC Ground-level releases[b]	2.30E-04
	2.	INTEC FAST Stack (CPP-767-001)	7.56E-07
		TOTAL:	2.31E-04
NRF			
	1.	NRF (A1W, A1W-RWDS, ECF, S1W, S5G)[b]	3.60E-04
		TOTAL:	3.60E-04
PBF			
	1.	PBF (PER-620-016)[b]	2.83E-09
	2.	WERF South (PER-756-001)[b]	1.15E-07
	3.	Mixed Waste Storage Facility – Repackaging Booth[b]	3.97E-09
		TOTAL:	1.22E-07
RWMC			
	1.	OCVZ, Drum Vent Facility, and Processing Tent[b]	9.24E-06
		TOTAL:	9.24E-06
TAN			
	1.	SMC (SMC Stacks S1-S14)[b]	1.88E-07
	2.	TSF Exhaust (TAN-734-001)	6.89E-08
	3.	Groundwater Treatment Unit (TAN OU 1-07B)[b]	4.77E-10
	4.	TAN 666-001, Waste Tank Vent[b]	3.24E-12
		TOTAL:	2.57E-07
TRA			
	1.	MTR Fumehoods (TRA-604-035, -072, -073, -074), TRA Hot Cell (TRA-632), Chem. Lab. Addition (TRA-661-008), and ATR Laboritories (TRA-670-074, -086, and -098)[b]	4.83E-05
	2.	MTR (TRA-710-001)	4.52E-07
	3.	ATR (TRA-770-001)	2.63E-03
	4.	ETR (TRA 753-001)	1.55E-06
		TOTAL:	2.68E-03
ALL FACILITIES			3.28E-03

a. The EDE shown is to the INEEL MEI.

b. Includes stack releases being modeled as ground-level releases due to building wake effects.

Table III-3. Summary Of 1998 Effective Dose Equivalents From Diffuse Sources At The INEEL

Release Area	EDE (mrem)[a]
ANL-W	0
CFA	2.60E-05
INTEC	5.78E-07
NRF	4.56E-06
PBF	4.03E-06
RWMC	2.36E-03
TAN	2.37E-06
TRA	5.42E-04
ALL FACILITIES	2.94E-03

a. The EDE shown is to the INEEL MEI.

Description of Dose Model and Summary of Input Parameters

General

The CAP-88 computer code (EPA 1990) was used to calculate the EDE from the INEEL releases. CAP-88 is approved for use by the EPA for demonstrating compliance with 40 CFR 61, Subpart H. Because the MEI for emissions from the INEEL facilities is more than 3 km from all emission sources, the COMPLY code was not used. The output from CAP-88 is the EDE, which includes the 50-year committed EDE (CEDE) from internal exposure through the ingestion and inhalation pathways and the external EDE from ground deposition and air immersion. The dose conversion factors are from the RADRISK dosimetric data base.

Site-specific 1998 wind data collected by the National Oceanic and Atmospheric Administration (NOAA) were used as input to the CAP-88 computer code (see Appendix C), with calm wind periods incorporated into the lowest windspeed class. Most INEEL facilities have NOAA stations onsite; the exception is INTEC, where Grid III station data were used. Grid III is located approximately 1.1 mi (1.8 km) north-northwest of INTEC. Table III-4 summarizes meteorological tower locations and heights of wind measurements. The sector-averaged option was chosen for the atmospheric dispersion calculations since this reflects annual average conditions within a sector.

The majority of the input data used in this analysis were default data from CAP-88. Input parameters differing from the CAP-88 defaults are listed in Appendix D with the associated value and reference.

Where appropriate, daughter progeny were included explicitly in the source term for the releases. Examples of parent/progeny pairs incorporated in the analyses are Cs-137/Ba-137m, Sr-90/Y-90, Ru-106/Rh-106, Sb-125/Te-125m, and Kr-88/Rb-88. The first three progeny of the U-238 decay series (Th-234, Pa-234, and Pa-234m) were modeled as being in secular equilibrium with U-238.

Point Sources

Emission points were modeled as either stack or ground-level releases based on EPA guidance (EPA 1989) and NCRP guidance (NCRP 1989). This guidance states that if the release height is less than or equal to 2.5 times the building height from which the stack emerges, then building downwash will lower the release height. For conservatism, these releases are included as ground-level point emissions. Stack-specific data for the INEEL emission points that were modeled as stack releases are provided in Table III-5.

Diffuse Sources

Diffuse sources at the INEEL include contaminated soil areas, fuel storage pools, evaporation ponds, etc. For this report, soil areas that were radiologically controlled (i.e., posted as a SOIL CONTAMINATION AREA) were considered potential source terms for diffuse emissions. The source term data for soils included conservative estimates of the surface area of each source and an estimate of the activity concentrations of specific radionuclides per unit mass or area. These data were used to estimate an annual release rate for each radionuclide, with units of Ci/yr, for input to CAP-88. Details of the source term calculations and the basis for the resuspension rate of 1E-12 s^{-1} for undisturbed soils are provided in Engineering Design File NES-94-002.1 maintained at the INEEL. Again, CAP-88 was used to calculate the resulting EDE. Diffuse sources were modeled as ground-level releases. Table II-10 (Section II) identified each release point for diffuse emissions, area of source, concentration, radionuclide inventory, and the release (Ci/g).

Table III-4. Sources of Wind Data for 1998 CAP-88 Atmospheric Dispersion Modeling of Releases From The INEEL Facilities

Facility	Met Tower Location	Measurement Level (m)	Averaging Period
ANL-W	ANL	10	1998
		80	
CFA	CFA	10	1998
INTEC	Grid III	10	1998
		61	
NRF	NRF	10	1998
PBF	PBF	10	1998
RWMC	CFA[a]	10	1998
TAN	TAN	10	1998
		45	
TRA	TRA	10	1998

a. Meteorological data from RWMC is considered unreliable because of construction activities; CFA data are substituted.

Table III-5. INEEL Stack Data For Releases Modeled As Stack Releases

Release Point	Measurement Level (m)	Stack Height (m)	Stack Diameter (m)	Stack Radius (m)	Stack Flow (m^3/s)	Stack Velocity (m/s)
ANL-764-001	80	61	1.55	0.78	23.1	12.2
CPP-767-001	61	48.8	1.65	0.82	11.4	5.3
CPP-708-001	61	76.2	1.98	0.99	45.9	14.9
TAN-734-001	45	48.8	1.14	0.57	4.3	4.3
TRA-710-001	10	76.2	1.52	0.76	5.7	3.2
TRA-753-001	10	76.2	1.52	0.76	5.7	3.2
TRA-770-001	10	76.2	1.52	0.76	20.0	11.3

Compliance Assessment

MEI Determination

The MEI was calculated based on a single receptor point. The MEI location was determined by executing a series of batch files prepared for the CAP-88 computer code, one for each major release point to each of the 63 potential MEI locations. Figures 2 through 10 illustrate the sector maps from each INEEL area and the 63 potential MEI locations. The output from these batch runs were then electronically transferred onto a spreadsheet and the offsite dose was calculated at each of the 63 potential MEI locations (NES-96-004). This spreadsheet is provided as Table III-6. The INEEL MEI was then readily obtained by selecting the offsite residence with the highest EDE. Once the MEI was located, emissions from all point and diffuse sources were modeled to this INEEL MEI point. For CY 1998, the MEI was receptor #1 (Frenchmen's Cabin).

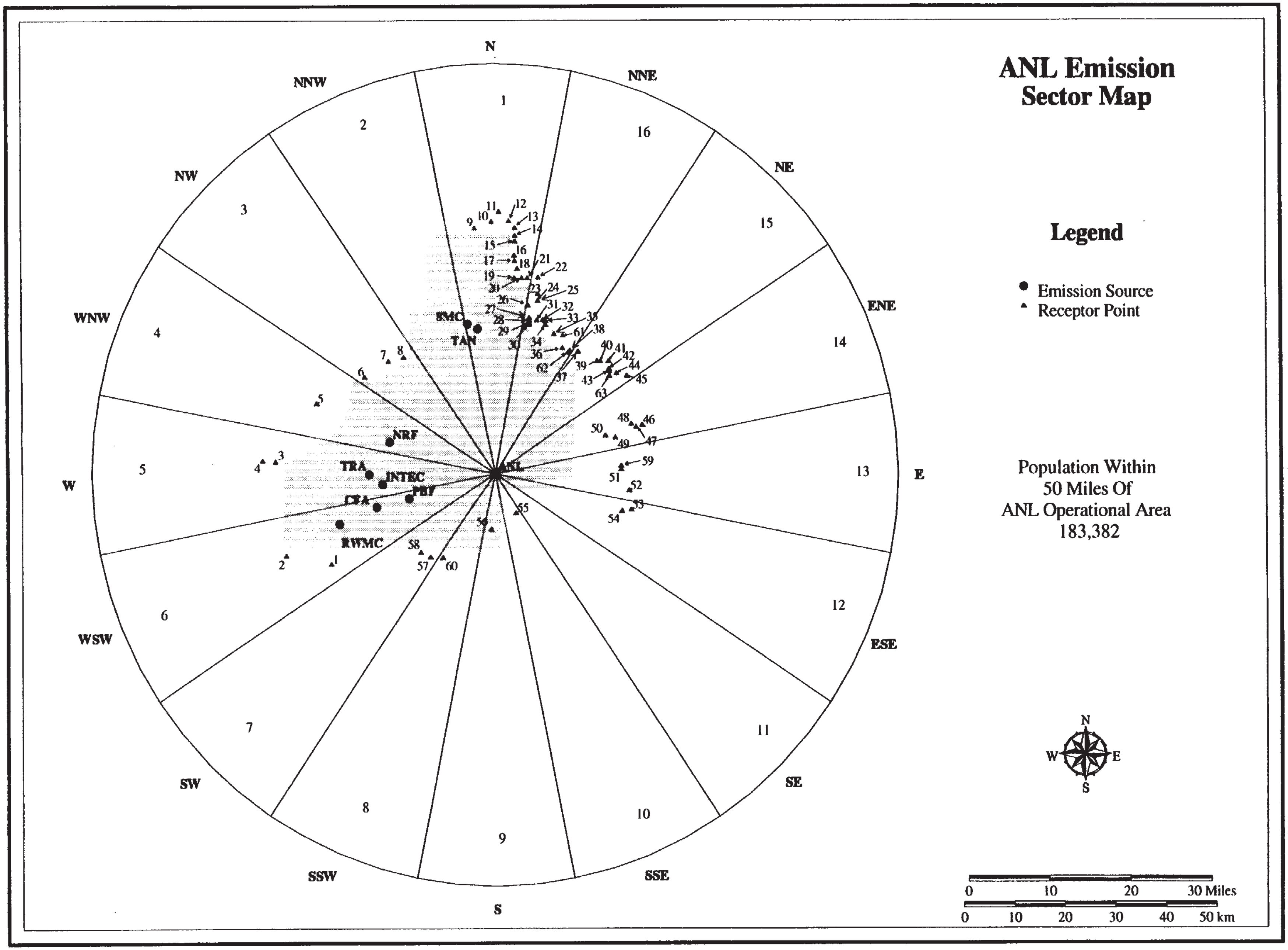

Figure 2. ANL-W Emission Sector Map

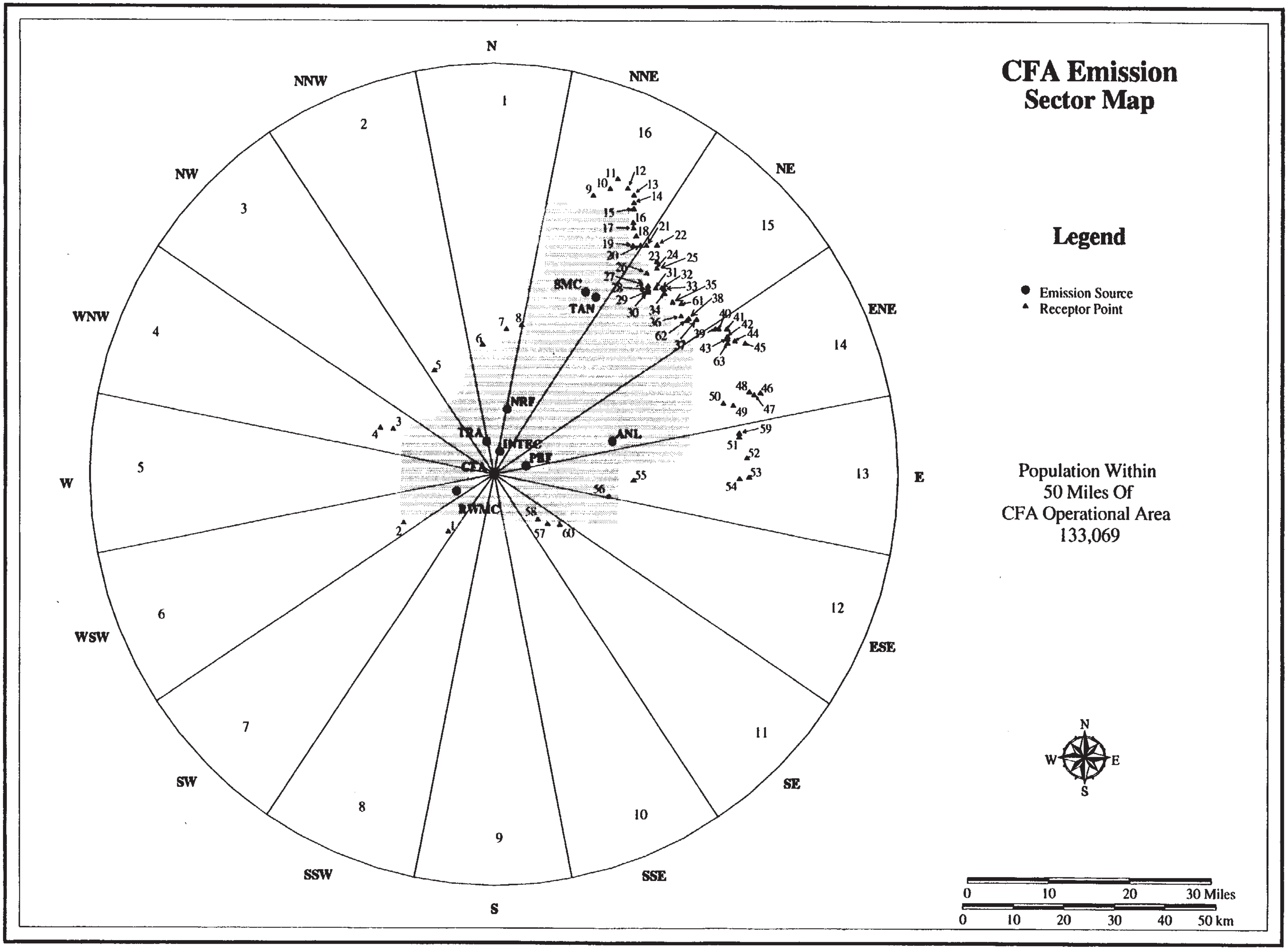

Figure 3. CFA Emission Sector Map

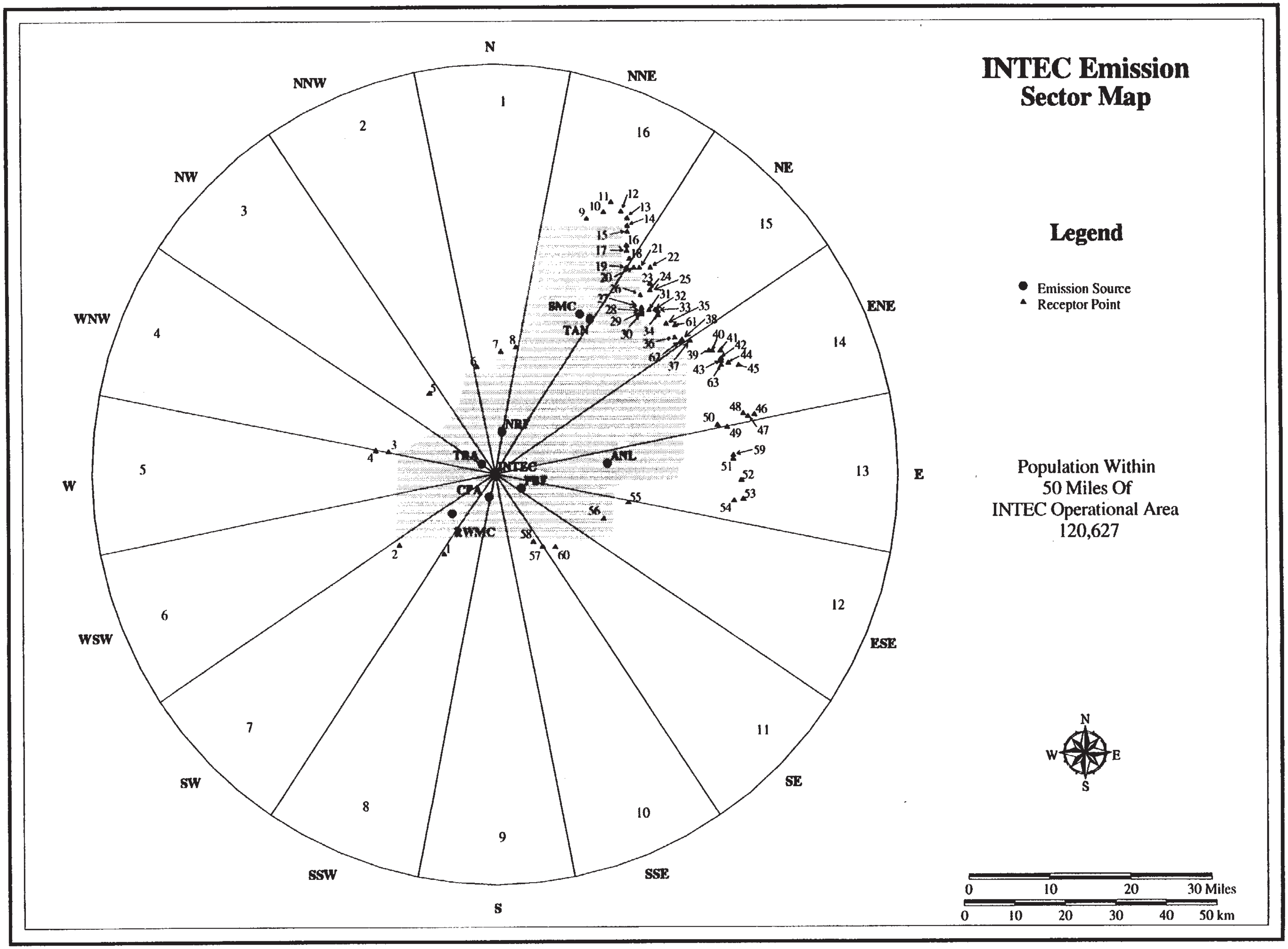

Figure 4. INTEC Emission Sector Map

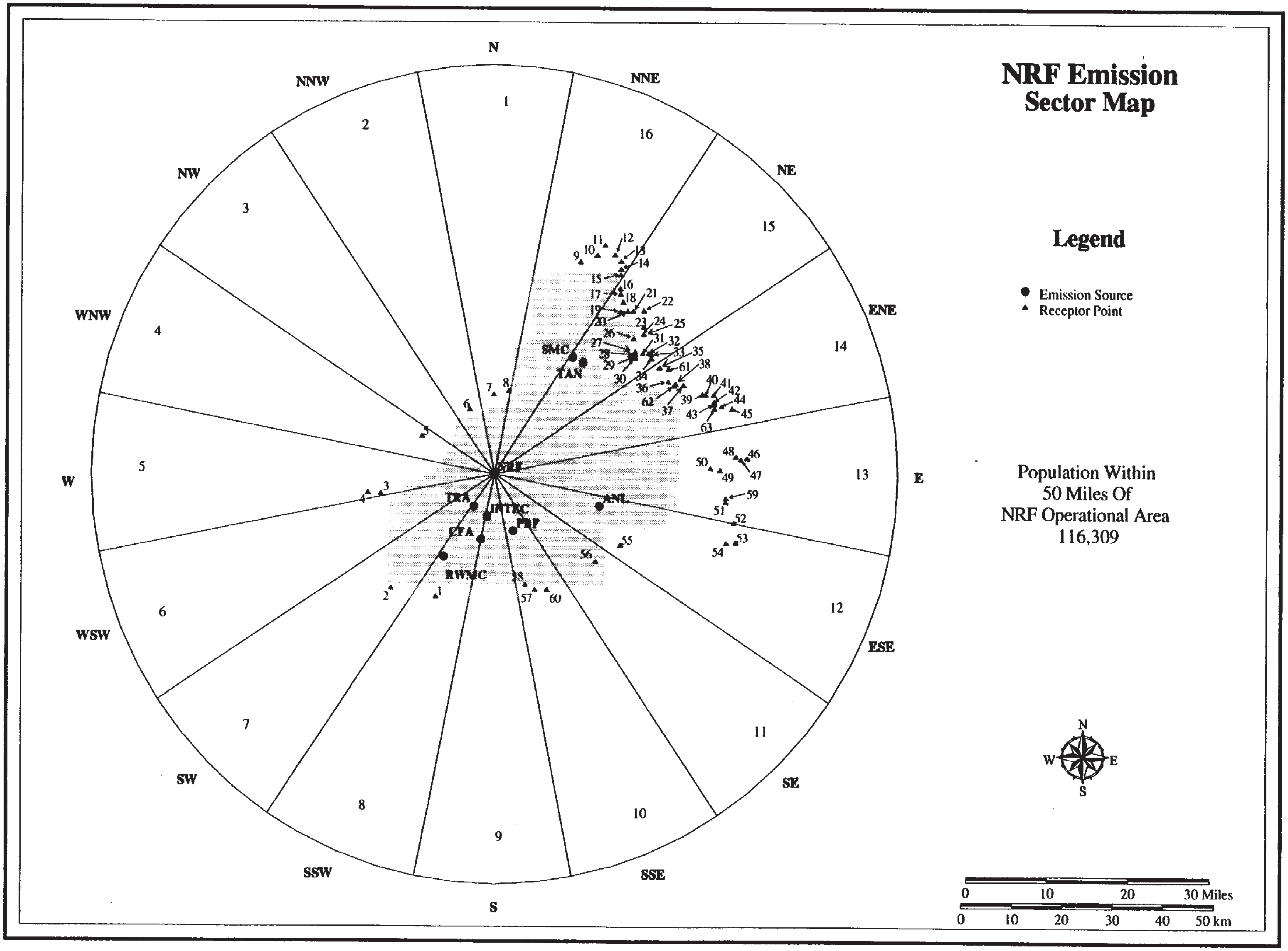

Figure 5. NRF Emission Sector Map

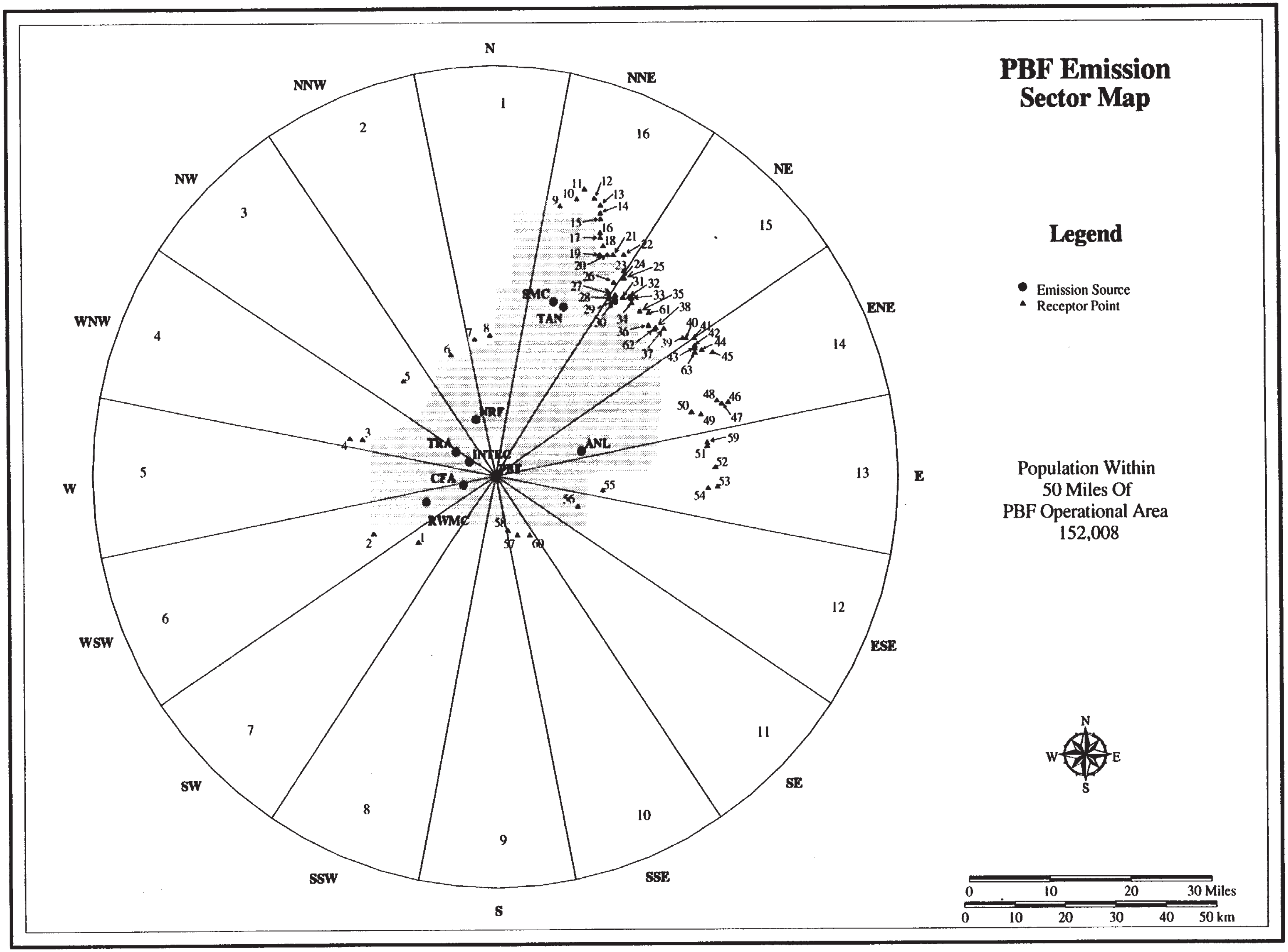

Figure 6. PBF Emission Sector Map

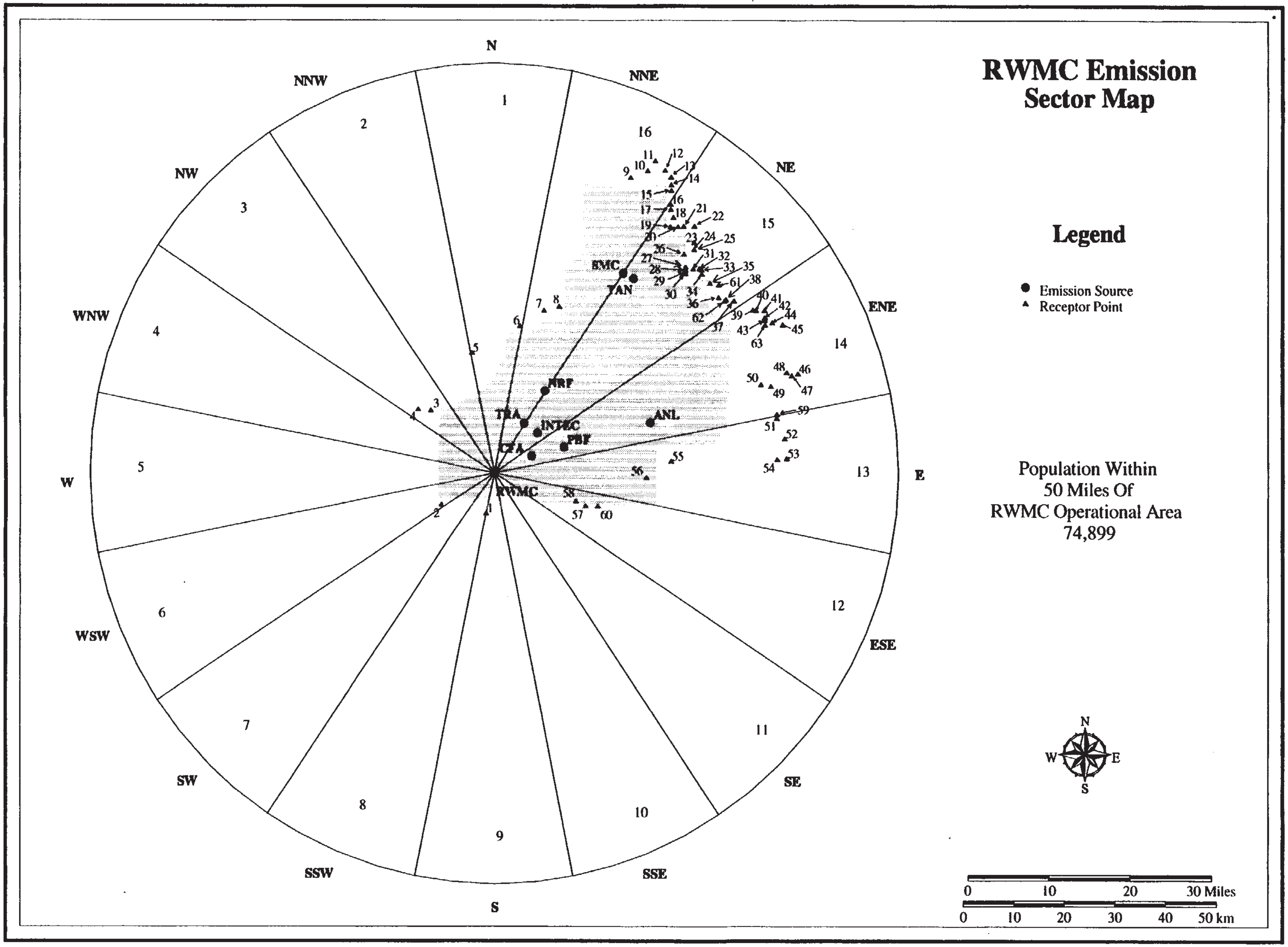

Figure 7. RWMC Emission Sector Map

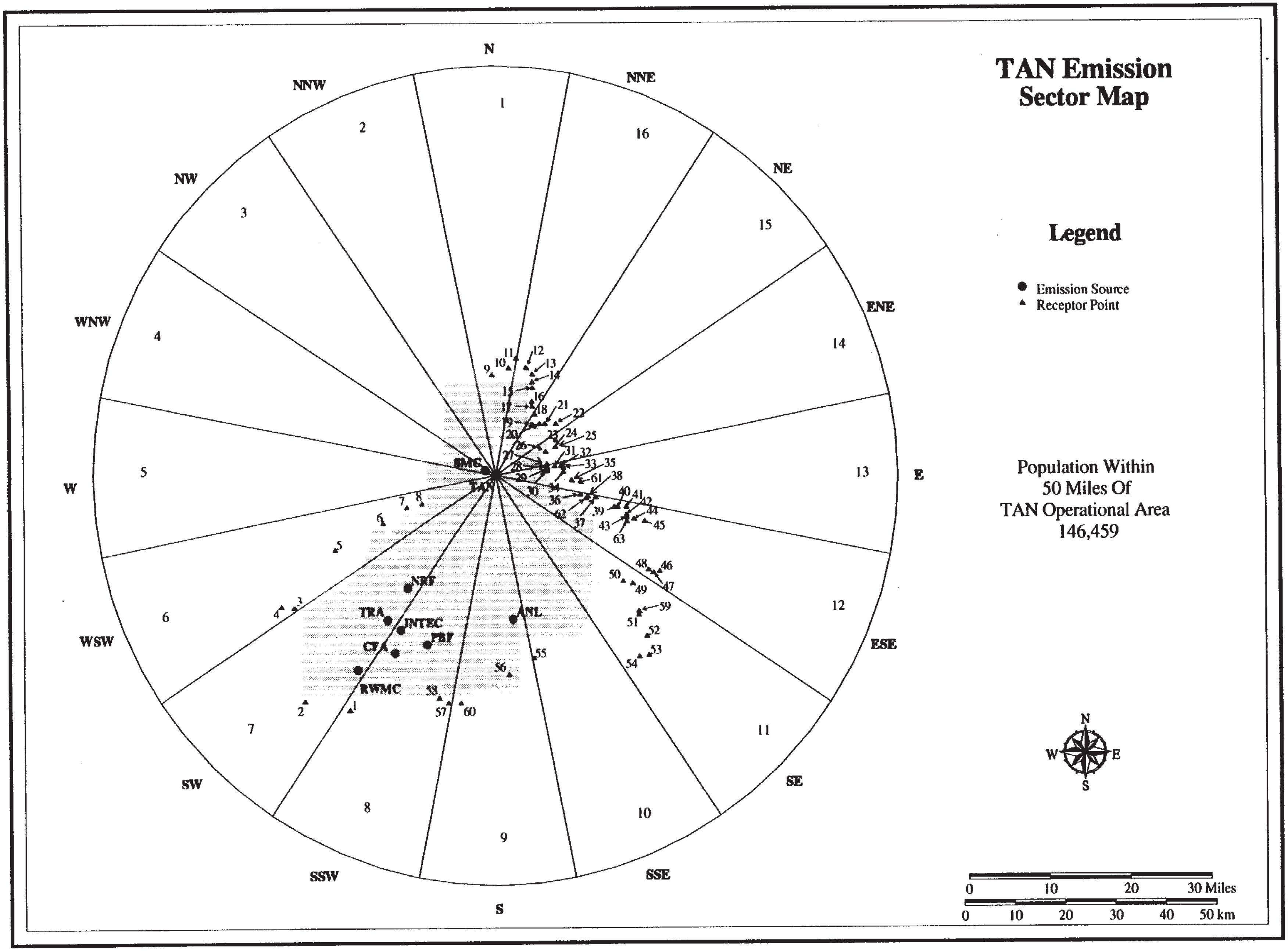

Figure 8. TAN Emission Sector Map

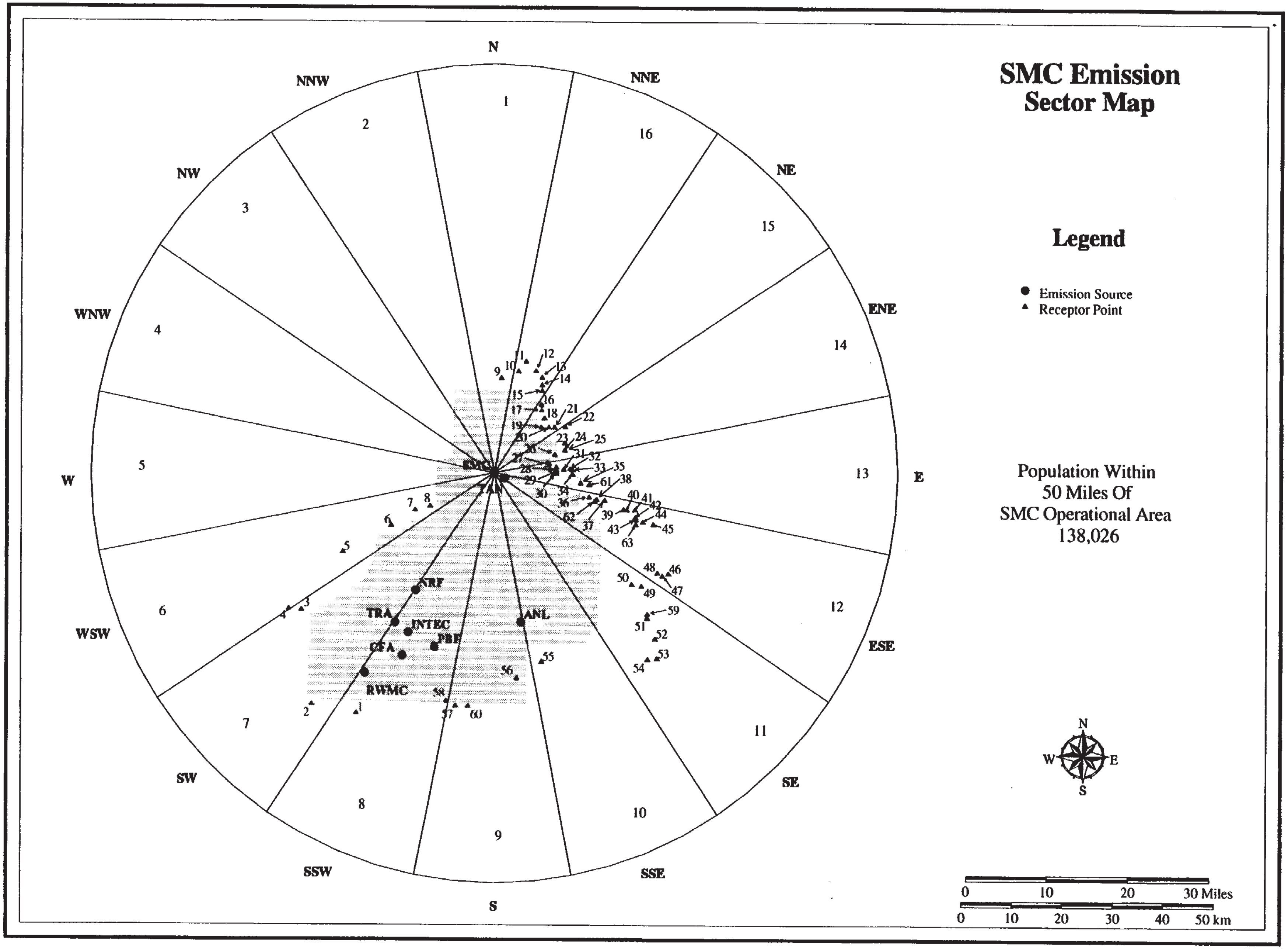

Figure 9. SMC Emission Sector Map

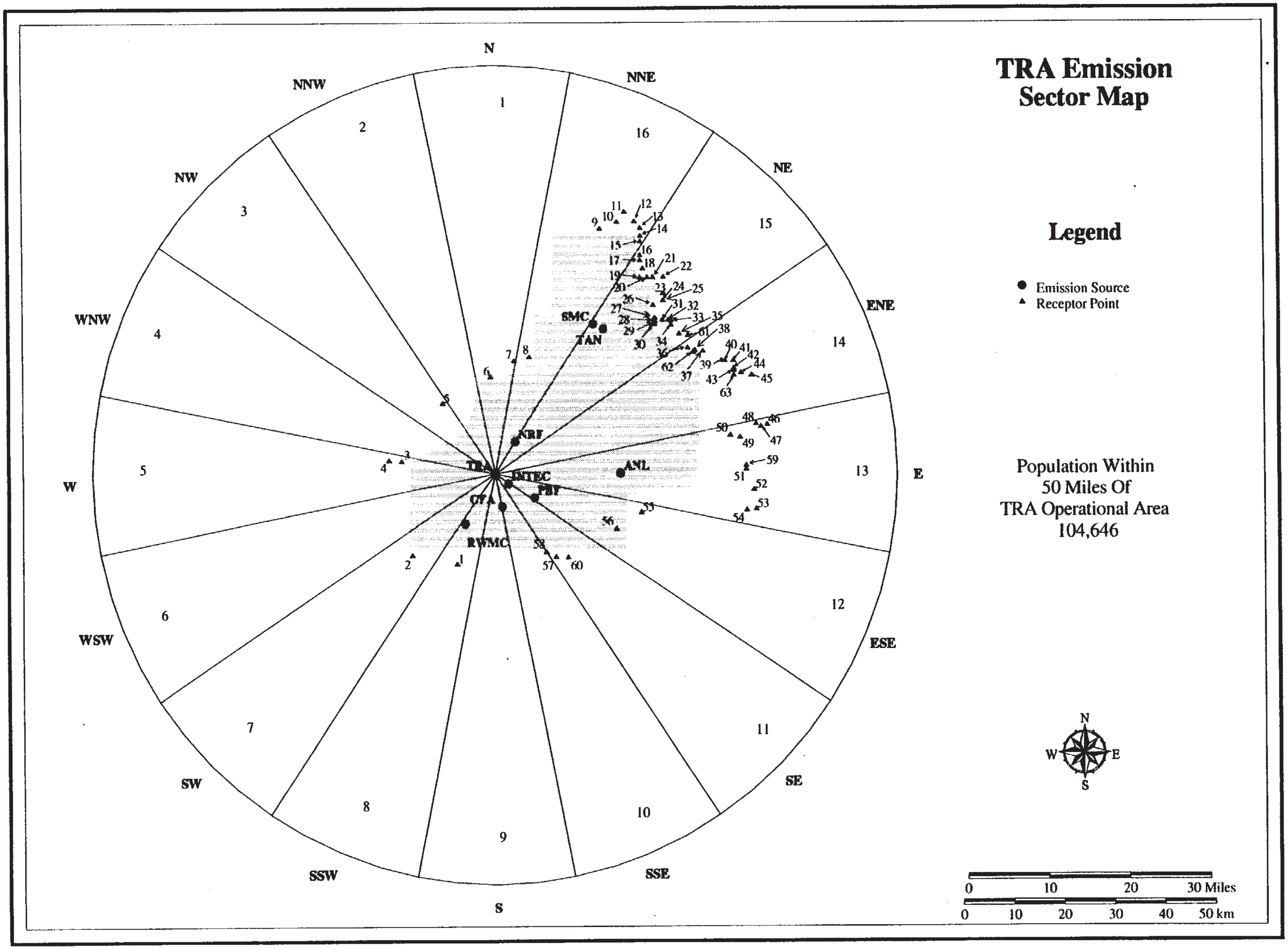

Figure 10. TRA Emission Sector Map

Table III-6. MEI Determination Table

Location	ANL	INTEC	NRF	RWMC	TRA-ATR	Total INEEL
1	4.26E-05	1.83E-03	3.66E-04	2.36E-03	2.63E-03	7.23E-03
2	3.49E-05	1.89E-03	3.61E-04	4.77E-04	2.27E-03	5.03E-03
3	1.60E-05	1.82E-04	2.30E-04	2.39E-04	5.78E-04	1.24E-03
4	1.51E-05	1.86E-04	2.04E-04	2.12E-04	4.67E-04	1.08E-03
5	1.71E-05	2.31E-04	2.84E-04	2.58E-04	4.01E-04	1.19E-03
6	2.31E-05	4.77E-04	3.45E-04	2.05E-04	9.29E-04	1.98E-03
7	2.43E-05	3.72E-04	4.49E-04	2.00E-04	7.13E-04	1.76E-03
8	2.55E-05	3.39E-04	4.18E-04	1.89E-04	1.38E-03	2.35E-03
9	2.75E-05	1.17E-04	1.89E-04	9.49E-05	3.17E-04	7.46E-04
10	2.67E-05	1.03E-04	1.77E-04	9.06E-05	2.88E-04	6.85E-04
11	2.55E-05	9.01E-05	1.67E-04	8.70E-05	2.64E-04	6.33E-04
12	2.66E-05	9.45E-05	1.70E-04	8.80E-05	2.71E-04	6.50E-04
13	2.74E-05	9.78E-05	1.72E-04	8.88E-05	2.76E-04	6.62E-04
14	2.85E-05	1.05E-04	1.78E-04	9.07E-05	2.89E-04	6.92E-04
15	2.93E-05	1.11E-04	1.82E-04	9.23E-05	2.99E-04	7.14E-04
16	3.15E-05	1.26E-04	1.68E-04	1.37E-04	6.35E-04	1.10E-03
17	3.24E-05	1.32E-04	1.72E-04	1.39E-04	6.56E-04	1.13E-03
18	3.39E-05	1.39E-04	1.76E-04	1.42E-04	6.82E-04	1.17E-03
19	3.58E-05	1.53E-04	1.86E-04	1.47E-04	7.35E-04	1.26E-03
20	3.56E-05	3.31E-04	1.81E-04	1.44E-04	7.06E-04	1.40E-03
21	3.54E-05	3.20E-04	1.77E-04	1.42E-04	6.86E-04	1.36E-03
22	4.94E-05	3.01E-04	1.70E-04	1.39E-04	6.49E-04	1.31E-03
23	5.48E-05	3.40E-04	1.81E-04	1.45E-04	7.14E-04	1.44E-03
24	5.74E-05	3.59E-04	1.87E-04	1.48E-04	7.46E-04	1.50E-03
25	5.74E-05	3.59E-04	1.87E-04	1.48E-04	7.46E-04	1.50E-03
26	6.02E-05	3.95E-04	1.99E-04	1.55E-04	8.12E-04	1.62E-03
27	6.59E-05	4.28E-04	2.08E-04	1.60E-04	8.69E-04	1.73E-03
28	6.75E-05	4.38E-04	2.11E-04	1.61E-04	8.85E-04	1.76E-03
29	6.85E-05	4.44E-04	2.12E-04	1.62E-04	8.97E-04	1.78E-03
30	6.96E-05	4.50E-04	2.15E-04	1.63E-04	9.06E-04	1.80E-03
31	6.61E-05	4.14E-04	2.02E-04	1.57E-04	8.38E-04	1.68E-03
32	6.49E-05	3.95E-04	1.96E-04	1.54E-04	8.03E-04	1.61E-03
33	6.52E-05	3.92E-04	1.95E-04	1.54E-04	7.97E-04	1.60E-03
34	6.73E-05	4.03E-04	1.97E-04	1.56E-04	8.15E-04	1.64E-03
35	7.02E-05	4.02E-04	1.14E-04	1.56E-04	8.08E-04	1.55E-03
36	7.56E-05	4.09E-04	1.14E-04	1.57E-04	5.43E-04	1.30E-03
37	8.34E-05	2.61E-04	1.06E-04	1.50E-04	4.94E-04	1.09E-03
38	7.43E-05	3.92E-04	1.10E-04	1.54E-04	5.20E-04	1.25E-03
39	8.02E-05	2.33E-04	9.83E-05	1.54E-04	4.47E-04	1.01E-03
40	7.89E-05	2.26E-04	9.68E-05	1.52E-04	4.37E-04	9.91E-04
41	7.53E-05	2.10E-04	9.31E-05	1.48E-04	4.13E-04	9.40E-04
42	7.81E-05	2.18E-04	9.39E-05	1.50E-04	4.21E-04	9.61E-04
43	7.91E-05	2.19E-04	9.43E-05	1.50E-04	4.24E-04	9.67E-04
44	7.65E-05	2.07E-04	9.14E-05	1.47E-04	4.05E-04	9.27E-04
45	7.25E-05	1.89E-04	8.74E-05	1.43E-04	3.79E-04	8.71E-04
46	5.41E-05	1.90E-04	7.92E-05	1.45E-04	1.38E-04	6.07E-04
47	5.68E-05	2.05E-04	8.15E-05	1.49E-04	1.45E-04	6.37E-04
48	5.84E-05	2.13E-04	8.33E-05	1.51E-04	1.49E-04	6.55E-04
49	6.89E-05	8.79E-05	9.02E-05	1.63E-04	1.71E-04	5.81E-04
50	7.48E-05	2.80E-04	9.48E-05	1.69E-04	1.83E-04	8.01E-04
51	3.71E-05	8.60E-05	8.70E-05	1.50E-04	1.66E-04	5.26E-04
52	3.47E-05	7.93E-05	8.26E-05	1.47E-04	1.56E-04	5.00E-04
53	2.99E-05	7.65E-05	4.52E-05	1.47E-04	1.52E-04	4.51E-04
54	3.19E-05	8.47E-05	4.71E-05	1.53E-04	1.63E-04	4.80E-04
55	1.67E-04	1.25E-04	8.39E-05	2.60E-04	2.11E-04	8.47E-04
56	2.11E-04	1.64E-04	1.37E-04	3.10E-04	2.62E-04	1.08E-03
57	2.12E-04	3.46E-04	2.28E-04	3.96E-04	3.95E-04	1.58E-03
58	2.05E-04	4.09E-04	2.46E-04	4.52E-04	4.64E-04	1.78E-03
59	3.71E-05	8.57E-05	8.71E-05	1.64E-04	1.66E-04	5.40E-04
60	1.84E-04	2.02E-04	2.18E-04	3.47E-04	3.49E-04	1.30E-03
61	6.88E-05	3.80E-04	1.10E-04	1.52E-04	7.65E-04	1.48E-03
62	7.60E-05	4.01E-04	1.12E-04	1.56E-04	5.31E-04	1.28E-03
63	8.10E-05	2.23E-04	9.49E-05	1.52E-04	4.29E-04	9.80E-04
** Revised 5/10/99 for change in TSUBB (soil buildup time) in PREPAR file						

Operational Area Modeling

Argonne National Laboratory - West

One emission point was modeled as a stack. Table III-5 contains the stack data used in the analyses.

- ANL-764-001 - Experimental Breeder Reactor II (EBR-II) and Fuel Conditioning Facility (FCF)

ANL-785-018 - Hot Fuel Examination Facility (HFEF) was modeled separately as a ground-level release. All remaining sources were modeled as a composite ground-level release.

The location of the INEEL MEI with respect to ANL-W was a residence, 37,219 meters (23.1 miles) west-southwest of ANL-W.

Central Facilities Area

The RESL laboratory vents were modeled as a composite ground-level release. The location of the INEEL MEI with respect to CFA was a residence, 14,359 meters (8.9 miles) southwest of CFA.

Idaho Nuclear Technical Engineering Center

Two emission points were modeled as stacks. Table III-5 contains the stack data used in the analyses.

- INTEC FAST stack (CPP-767-001)
- INTEC in stack (CPP-708-001).

All remaining sources were modeled as a composite ground-level release.

The location of the INEEL MEI with respect to INTEC was 18,718 meters (11.6 miles) south-southwest of INTEC.

Naval Reactors Facility

See Appendix A.

The location of the INEEL MEI with respect to NRF was a residence, 26,675 meters (16.6 miles) south-southwest of NRF.

Power Burst Facility Area

All sources were modeled as a composite ground-level release.

The location of the INEEL MEI with respect to PBF was 20,141 meters (12.5 miles) southwest of PBF.

Radioactive Waste Management Complex

All RWMC sources were modeled as a composite ground-level release.

The location of the INEEL MEI with respect to the RWMC was 7,976 meters (4.9 miles) south-southwest of RWMC.

Test Area North (including Specific Manufacturing Capability)

One emission point was modeled as a stack. Table III-5 contains the stack data used in the analyses.

- TAN TSF Exhaust (TAN-734-001).

The location of the nearest receptor for this stack was a residence/farm 13.0 km north-northeast of TAN. The remaining release points at TAN were modeled as a composite ground-level release. The location of the INEEL MEI with respect to TAN was a residence, 54,612 meters (33.9 miles) south-southwest of TAN.

The 14 SMC emission points were modeled as a composite ground-level release. The location of the INEEL MEI with respect to SMC was 54,405 meters (33.8 miles) south-southwest of SMC.

Test Reactor Area

Three emission points were modeled as stacks. Table III-5 contains the stack data used in the analyses.

- MTR Stack (TRA-710-001)
- ETR Stack (TRA-753-001)
- ATR Stack (TRA-770-001).

The Alpha Lab, TRA Hot Cell, Chemistry Laboratories and additional emission points were modeled as a composite ground-level release.

The location of the INEEL MEI with respect to TRA was 19,172 meters (11.9 miles) south-southwest of TRA

IV. Construction/Modification Projects

Section 61.94(b)(8) of 40 CFR 61 requires that an annual report identify and briefly describe all construction and modifications (completed in the applicable calendar year) for which the requirement to apply for approval to construct or modify was waived under Section 61.96. NRF construction and modifications are discussed in Appendix A. For CY 1998 no projects were completed.

V. REFERENCES

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APPENDIX A

Naval Reactors Facility

Radionuclide Air Emissions Report

BETTIS-IDAHO

Calendar Year 1998

1998

Naval Reactors Facility (NRF)

National Emission Standards

for Hazardous Air Pollutants

(NESHAP) - Radionuclides

Annual Report

June 1999

Prepared for the U.S. Department of Energy
by Bechtel Bettis, Incorporated
Under Contract No. DE-AC9838206

BECHTEL

U. S. Department of Energy
Radionuclide Air Emissions Annual Report
(under Subpart H of 40 CFR Part 61)
Calendar Year 1998

Site Name: Idaho National Engineering and Environmental Laboratory (INEEL)

Area: Naval Reactors Facility (NRF)

Area Information for NRF

Operator: Bechtel Bettis, Incorporated

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Idaho Falls, Idaho 83403-2068

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I. FACILITY INFORMATION

Site Description

The Naval Reactors Facility (NRF) is operated for the Department of Energy (DOE) by Bechtel Bettis, Incorporated and is located on the Idaho National Engineering and Environmental Laboratory (INEEL) Site (Figure 1). NRF is located approximately 8.1 miles (13,100 meters) north of the Central Facilities Area (CFA) and 6.7 miles (10,800 meters) from the nearest INEEL border. The nearest population center is Howe which is located approximately 10.1 miles (16,200 meters) from NRF. Howe has approximately 20 residents. In addition, there are individual homes, farms, and ranches located in close proximity to the INEEL boundaries surrounding NRF. Section III provides specific information concerning the distances to locations used for dose modeling.

The climate of the INEEL is characterized as semi-arid. The INEEL is located on the Snake River Plain with an elevation of approximately 5000 feet (1500 meters), and it is surrounded by mountains. Air masses entering the Snake River Plain from the west lose most of their moisture to precipitation prior to encountering the INEEL; therefore, annual precipitation at the INEEL is light. Winds are channeled over the Snake River Plain by bordering mountain ranges so that a southwest wind predominates over the INEEL. The second most frequent winds are from the northeast. The average air temperature, average wind speed, and the average precipitation are included in the CAP-88 computer code calculations.

The Expended Core Facility (ECF) and three naval nuclear prototypes (S1W, A1W, and S5G) are located on the developed portion of NRF, which covers 84 acres (34 hectares). ECF is a large laboratory designed to receive, handle, examine, measure, and test naval nuclear reactor fuel modules and engineering test specimens. The three prototypes, when operating, were utilized to test advanced Naval Reactors components and to train United States Navy personnel for service aboard nuclear-powered ships. The S1W, A1W, and S5G prototypes concluded operation in October 1989, January 1994, and May 1995, respectively. At present, the S1W and the S5G prototypes are defueled and in systems layup, and the A1W prototype is defueled and is being placed into systems layup.

Source Descriptions

NRF receives spent fuel and radioactive components from the U. S. Naval Nuclear Propulsion Program, shipped in DOE/Nuclear Regulatory Commission (NRC) approved shipping containers in accordance with Department of Transportation requirements. The shipments are processed and examined at the Expended Core Facility.

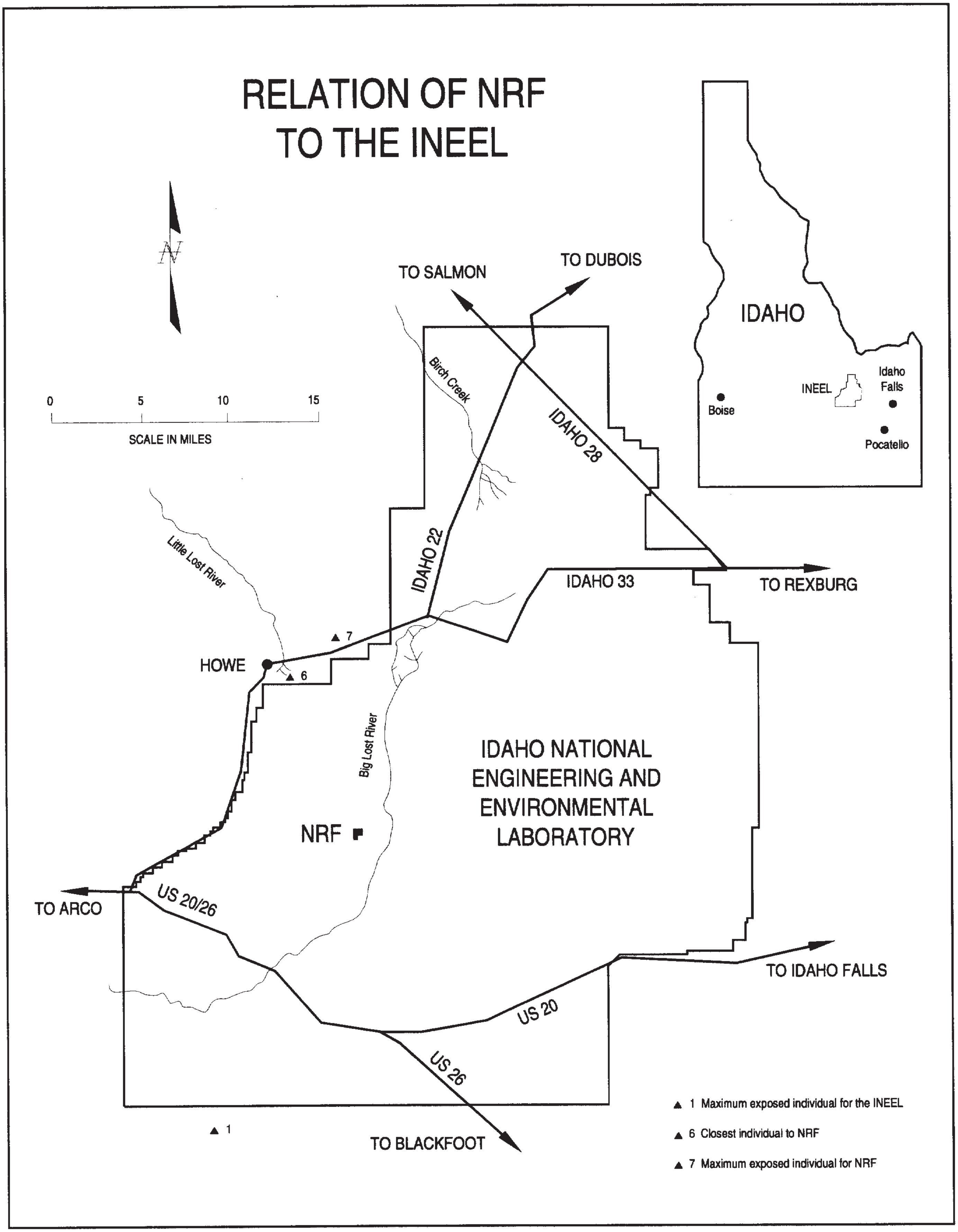

Figure 1. Relation of NRF to the INEEL.

After processing and examination, the naval fuel is transported to the Idaho Nuclear and Engineering Technology Center (INTEC).

Radioactive materials at NRF include enriched uranium fuel with associated fission products, activation products, and activated corrosion and wear products. The principal activation products of concern are carbon-14 and tritium. The corrosion and wear products are present as insoluble metal oxide particles with cobalt-60 being the predominant radionuclide. Various sources are used for calibrating and checking equipment, verifying shielding, and performing radiography. The sources include cobalt-60, cesium-137, and iridium-192. Soil with low levels of cobalt-60 and cesium-137 from fallout and from past operations is also present at NRF.

Radioactive materials are handled and processed in several areas at NRF, including shielded cells, chemical and metallurgical laboratories, machine shops, and radioactive material storage containers. Physical, chemical, and metallurgical testing of small quantities of highly radioactive material specimens is performed in the ECF shielded cells. Radioactive work is performed in appropriate containment; storage and movement of radioactive materials is under strict control. Machine shops are used to perform machining operations such as turning, milling, and drilling on a variety of metal components. Though infrequently used, special laboratory facilities are available for the chemical analysis of potentially radioactive and low-level radioactive samples.

All radioactive material is controlled by a Radioactive Material Accountability system and maintained in designated storage areas. All movements of radioactive material within the facility are performed under escort of qualified radiological controls personnel and recorded in the accountability system.

Radioactive liquids are utilized in support facilities. The majority of radioactive liquids are processed through a series of filters and demineralizers for reuse. Radioactive liquids which cannot be reused are solidified for storage or disposal as radioactive waste.

Disposable materials and waste products associated with the handling of radioactive materials are controlled and tracked as radioactive wastes. These waste materials are segregated into compactible wastes, non-compactible wastes, dewatered resin/carbon media, and solidified liquids. The wastes are temporarily stored on-site in designated storage areas until sufficient quantities accumulate to comprise a shipment to a DOE low-level disposal site.

Radionuclide emissions to the atmosphere can come from six main sources at NRF. These are (1) A1W, (2) A1W Radioactive Waste Processing System (RWPS), (3) S5G, (4) S1W, (5) ECF, and (6) fugitive sources.

(1) The shutdown A1W prototype plant (Buildings 616A - C and 617A - C) handles chromated water and plant discharge water, which is reused after radionuclides and impurities are

removed. As part of the defueling and systems layup preparations, A1W also handles contaminated materials such as tools, equipment, anti-contamination clothing, and contaminated waste.

(2) The A1W RWPS (Building 628A) is used for the removal of radionuclides and impurities from primary plant water drained from the A1W prototype plant during defueling and systems layup preparations.

(3) The shutdown S5G prototype plant (Building 633A - B) handles chromated water and plant discharge water, which is reused after radionuclides and impurities are removed. A radioactive waste processing system is used for the removal of radionuclides and impurities from primary plant water from the S5G prototype plant. As part of the systems layup preparations, S5G also handles contaminated materials such as tools, equipment, anti-contamination clothing, and contaminated waste.

(4) The S1W prototype (Building 601) is no longer operational and has been inactivated; however, there are some ventilation systems which are still in use. Work is done with radioactive material during chemistry analyses in the NRF Chemistry wing of this building. Other ventilation systems in the building are in use to control the buildup of naturally occurring radon.

(5) The Expended Core Facility (ECF Building 618) handles spent fuel from naval cores and contaminated materials such as anti-contamination clothing, tools, and other equipment. Radioactive water is present in the pits where fuel is located. Analyses are performed on radioactive materials in chemistry laboratories in this building. ECF uses excess decontaminated water from the A1W and S5G prototypes to replenish evaporation from the large water pits.

(6) Fugitive sources are diffuse emissions not associated with a specific building vent. These sources represent fugitive soil emissions and portable blowers used on temporary containments that do not exhaust directly to the environment or to an area exhausted by a permanent ventilation system. Portable blowers are used to ensure negative pressure in containments, provide particulate control, and, in some confined spaces, maintain occupational health and safety standards. Fugitive soil sources are emissions from defined areas surrounding NRF which potentially contain low levels of radioactivity that are exposed to the wind.

II. AIR EMISSIONS DATA

NRF has a number of stacks and vents with the potential to emit low quantities of radionuclides. These emissions are monitored and calculated by NRF, and the results are reported to the INEEL Environmental System (IES) on a monthly basis. The data is included in the calculation of the INEEL's annual effective dose equivalent (EDE) to members of the public.

Continuous monitoring is required by 61.93(b) of 40 CFR 61, Subpart H, for emission points that have a potential to emit radionuclides in quantities that could result in an EDE to a member of the pubic in excess of 1 percent of the 10 millirem per year NESHAPs standard, which is 0.1 millirem. As part of the INEEL assessment of radiological emission points, NRF evaluated all emission sources in 1990, as reported in DOE/ID-10310, *NESHAPs 40 CFR 61.93 Monitoring Requirements for Radiological Emission Sources at INEL.* An evaluation was again performed for the 1995 INEEL Title V, Tier I Operating Permit Application. None of the emission points at NRF qualify for the continuous monitoring requirement; all emission points are below the 0.1 millirem per year criteria. Confirmatory evaluations are performed as needed to verify that emissions are below 1 percent of the standard.

Table II-1 identifies potential point sources of radionuclide air emissions. The table contains identification codes for area, building, and vent; a general description for each of the potential emission points; a description of the effluent controls and their efficiencies, if applicable; and those emission sources which were monitored.

Table II-2 lists the combined radionuclide emissions from the point sources for calendar year 1998. This data represents those sources which are routinely monitored. Unmonitored emissions, which are calculated, are also included.

Table II-3 identifies potential fugitive sources of radionuclide air emissions. This category contains two types of sources. The first type includes buildings which do not have a stack or vent. The second type identifies areas where soil which potentially contain low levels of radioactivity is exposed to the wind. The table contains codes for area, building or location, and an identification code for tracking; a general description for each of the potential emission points; a description of the effluent controls and their efficiencies, if applicable; and those emission sources which were monitored.

Table II-4 lists the combined radionuclide emissions from the fugitive sources for calendar year 1998. This table includes measured values for those sources which are routinely monitored and calculated values for unmonitored emissions.

Tables II-2 and II-4 include gross alpha and gross beta radioactivity. For determining the EDE, the gross alpha is modeled as plutonium-239 and the gross beta is modeled as strontium-90 with yttrium-90 daughter progeny. This is consistent with other facilities located on the INEEL site. For fugitive soil sources, cesium-137 and the daughter progeny barium-137m are included.

Table II-1. NRF Potential Radiological Air Emission Point Sources

NAVAL REACTORS FACILITY (NRF)
NNW
Nearest Receptor - 13714 meters

AREA	BLDG.	VENT	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[1]	MONITORED[2]
NRF	601	019A	S1W MAIN STACK EXHAUST: CHEMISTRY LABORATORY FUME HOODS	HEPA FILTER	99.95%	☮
NRF	601	023	S1W REACTOR COMPARTMENT EXHAUST	HEPA FILTER	99.95%	✂
NRF	601	HBRV	S1W HIGH BAY ROOF VENTS	NONE[3]		X
NRF	616	012, 021	A1W OPERATIONS BUILDING	NONE[3]		X
NRF	616	039	A1W RADIOCHEMISTRY AND COUNTING ROOMS	HEPA FILTER	99.95%	✂
NRF	616	PCMA	A1W PRIMARY COMPONENTS MAINTENANCE AREA AND EXTENSION	NONE[3]		✂
NRF	616A	002	A1W REACTOR COMPARTMENT EXHAUST	HEPA FILTER	99.95%	X
NRF	617	002	A1W MACHINERY ROOM SPACES EXHAUST	NONE[3]		✂
NRF	617	013	A1W REACTOR COMPARTMENT 3A EXHAUST	NONE[3]		X
NRF	617	020, 021	A1W REACTOR COMPARTMENT 3B EXHAUST	NONE[3]		X
NRF	618	099	ECF STACK NUMBER 1	HEPA FILTER CARBON FILTER	99.95% 99.9%	☮
NRF	618	103	ECF STACK NUMBER 2	HEPA FILTER CARBON FILTER	99.95% 99.9%	☮
NRF	618	HBRV	ECF HIGH BAY ROOF VENTS	NONE[3]		X
NRF	628A	006	TANK VENT	HEPA FILTER	99.95%	✂
NRF	633A	057	S5G RADIOACTIVE AREA VENTILATION (RAV) SYSTEM	HEPA FILTER	99.95%	X
NRF	633A	HBRV	S5G HIGH BAY ROOF VENTS	NONE[3]		X
NRF	MSC	-	MISCELLANEOUS POINT SOURCES[4]	HEPA FILTER	99.95%	✂

1. High efficiency particulate air (HEPA) filters are tested by the manufacturer prior to delivery to NRF and by NRF during the life of the filter. The manufacturer tests the efficiency for 0.3-micron monodispersed dioctylphthalate (DOP) particles to a minimum of 99.97 percent. NRF tests the efficiency for 0.7-micron polydispersed DOP particles to a minimum of 99.95 percent.

2. An X indicates that the point source is monitored. A ☮ indicates that the point source has both monitored and unmonitored emissions in this report. A ✂ indicates that the source is monitored when required.

3. Subsystems which exhaust within the areas ventilated by these sources may have HEPA filters.

4. This includes sources such as temporary systems required to support defueling and systems layup work.

Table II-2. Point Source Releases From NRF During 1998

Radionuclide	Release (curies)	Release (becquerels)*
Carbon-14 (C-14)	8.1E-01	3.0E+10
Gross alpha {modeled as plutonium-239 (Pu-239)}	5.4E-06	2.0E+05
Gross beta {modeled as strontium-90 (Sr-90)/yttrium-90 (Y-90)}	8.7E-05	3.2E+06
Tritium (H-3)	4.9E-02	1.8E+09
Mercury-203 (Hg-203)	7.6E-08	2.8E+03
Iodine-131 (I-131)	1.0E-05	3.7E+05
Kr-85	3.0E-01	1.1E+10

* Note: 1 curie equals 3.7E+10 becquerels.

Table II-3. NRF Potential Radiological Air Emission Fugitive Sources

NAVAL REACTORS FACILITY (NRF) NNW				Nearest Receptor - 13714 meters		
AREA	BLDG/ LOCATION	I.D. CODE	SOURCE DESCRIPTION	EFFLUENT CONTROL DESCRIPTION	EFFICIENCY[1]	MONITORED[2]
NRF	605	(NONE)	S1W PUMP HOUSE: FUGITIVE	NONE[3]		X
NRF	631	(NONE)	RADIOACTIVE COMPONENT STORAGE WAREHOUSE: FUGITIVE	NONE[3]		X
NRF	642	(NONE)	CELITE TANK HOUSE: FUGITIVE	NONE[3]		X
NRF	MSC	-	MISCELLANEOUS FUGITIVE SOURCES[4]	HEPA FILTER	99.95%	✂
NRF	SOIL	001	S1W LEACHING PIT (NOT IN USE): FUGITIVE SOIL SURROUNDING COVERED AREA	NONE		
NRF	SOIL	002	A1W LEACHING PIT (NOT IN USE) AND SURROUNDING AREA: FUGITIVE SOIL	NONE		
NRF	SOIL	003	SOUTHWEST SEWAGE LAGOON: FUGITIVE SOIL IN DRY SEWAGE	NONE		
NRF	SOIL	004	NRF PERIMETER AREA: FUGITIVE SOIL	NONE		

1. High efficiency particulate air (HEPA) filters are tested by the manufacturer prior to delivery to NRF and by NRF during the life of the filter. The manufacturer tests the efficiency for 0.3-micron monodispersed dioctylphthalate (DOP) particles to a minimum of 99.97 percent. NRF tests the efficiency for 0.7-micron polydispersed DOP particles to a minimum of 99.95 percent.

2. An X indicates that the source is monitored. A ✂ indicates that the source is monitored when required. A blank indicates that the emissions are not monitored.

3. Subsystems which exhaust within the areas ventilated by these sources may have HEPA filters.

4. This includes sources such as temporary systems required to support defueling and systems layup work.

Table II-4. Fugitive Source Releases From NRF During 1998

Radionuclide	Release (curies)	Release (becquerels)*
Cobalt-60 (Co-60)	8.2E-06	3.0E+05
Cesium-137 (Cs-137)/barium-137m (Ba-137m)	9.2E-05	3.4E+06
Gross alpha {modeled as plutonium-239 (Pu-239)}	1.0E-07	3.7E+03
Gross beta {modeled as strontium-90 (Sr-90)/yttrium-90 (Y-90)}	2.2E-04	8.1E+06

* Note: 1 curie equals 3.7E+10 becquerels.

III. DOSE ASSESSMENTS

Summary

Table III-1 summarizes the EDE results for point sources, fugitive sources, and all sources combined. The EDE from all NRF sources at the receptor receiving the highest dose is 4.5×10^{-4} millirem (4.5×10^{-3} microsievert) and occurred at a location 15.8 kilometers north of NRF. The EDE from point sources is 4.4×10^{-4} millirem (4.4×10^{-3} microsievert) and the EDE from fugitive sources is 6.7×10^{-6} millirem (6.7×10^{-5} microsievert). The NRF EDE is for information only. The emissions for which this dose was calculated have been included in the INEEL calculation of the total EDE. It is the INEEL total EDE that is used to demonstrate compliance with the 40 CFR 61.92 standard of 10 millirem per year.

Subpart H of 40 CFR 61 requires that emissions of radionuclides to the ambient air from Department of Energy facilities shall not exceed those amounts which would cause any member of the public to receive in any year an EDE of 10 millirem (100 microsievert) per year. "Member of the public" is any offsite point where there is a residence, school, business, or office. For compliance purposes, this EDE is calculated for all emission sources on the INEEL. The EDE calculated for NRF is for information only; the emissions used for the NRF EDE have been included in the INEEL calculation of the EDE for the maximally exposed individual.

Description of Dose Model and Summary of Input Parameters

General

The CAP-88 computer code is used to calculate the EDE from NRF releases. CAP-88 is approved for use by the Environmental Protection Agency (EPA) for demonstrating compliance with 40 CFR 61 Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities." Two other approved computer codes are available for calculating the EDE. The COMPLY computer code was not used because the maximally exposed individual for emissions is more than 3 kilometers from emission sources. The AIRDOS-PC code was not used because it does not include several radionuclides that are released from facilities at the INEEL.

The output from CAP-88 is the EDE, which includes the 50-year committed and external EDEs. The committed EDE calculates internal exposure from ingestion and inhalation pathways, while the external EDE determines exposure from ground deposition and air immersion. The dose conversion factors are from the RADRISK dosimetric data base.

The population data set used in the CAP-88 calculations is based on the 1990 census. Locations were measured during the INEEL 1995 aerial survey. It is assumed that members of the population grow their own vegetables and raise their own beef and dairy cattle.

The wind file used in the CAP-88 calculations is derived from data obtained from the National Oceanic and Atmospheric Administration (NOAA). The wind data was collected during 1998 at the NRF 10-meter meteorological tower. Calm hours are apportioned into the lowest wind speed class. The sector-averaged option is used for the atmospheric dispersion calculations, because this reflects annual average conditions within a sector.

Where appropriate, daughter progeny were included in the source term for releases. Gross beta is modeled as strontium-90 with yttrium-90 daughter progeny; this is consistent with other facilities located on the INEEL site. The daughter progeny barium-137m is included for cesium-137.

Point Sources

Since none of the emission points at NRF are more than 2.5 times the building height, all emissions were considered to occur at ground level. All emissions from NRF were modeled as a single release point.

Fugitive Sources

Fugitive soil releases, included in fugitive sources, were calculated using soil resuspension rates of approximately one percent per year. The method used for determining resuspension rates is described in DOE/TIC-22800, Transuranic Elements in the Environment, by Wayne C. Hanson.

Compliance Assessment

Maximally Exposed Individual

Various receptors near the INEEL boundary were evaluated when calculating the highest EDE for 1998. The nearest receptor to NRF is a residence located approximately 8.5 miles (13.7 kilometers) to the north-northwest of NRF (Figure 1, Location 6), but it did not receive the highest dose. The receptor that received the highest dose from NRF is a residence located approximately 9.8 miles (15.8 kilometers) to the north of NRF (Figure 1, Location 7). The nearest receptor did not receive the highest dose, because it was not in the direction of the prevailing winds. The receptor that received the highest dose from all INEEL sources is located approximately 16.6 miles (26.7 kilometers) to the south-southwest of NRF (Figure 1, Location 1). The EDE results presented for NRF are for the receptor that received the highest dose from NRF (Figure 1, Location 7).

Table III-1. Summary of 1998 Effective Dose Equivalents from Point Sources and Diffuse Sources at NRF

	Release Point	EDE[1] (mrem)	EDE[1] (μSv)[2]
NRF			
1.	Point Sources[3]	4.4E-04	4.4E-03
2.	Fugitive Sources	6.7E-06	6.7E-05
	TOTAL:	**4.5E-04**	**4.5E-03**

1. The EDE shown is for the NRF maximally exposed individual (Figure 1, Location 7).

2. Note: 1 millirem equals 10 microsievert.

3. This includes stack releases being modeled as ground level releases due to building wake effects.

Statement of Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this report, the 1998 Naval Reactors Facility National Emission Standards for Hazardous Air Pollutants (NESHAPs) - Radionuclide Annual Report. Based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001.

Owner Signature:	______________________________	
	(T. M. Bradley)	(Date)
Title:	Manager, Naval Reactors Idaho Branch Office	
For:	Naval Reactors Facility	

IV. Additional Information

The EPA requires in 40 CFR 61 Subpart H that a brief description of all construction and modifications which were completed in 1998, but for which the requirement to apply for approval to construct or modify was waived, be included. No new construction or modification was completed in 1998 which would result in a potential increase in radionuclide airborne emissions.

V. SUPPLEMENTAL INFORMATION

The following information is provided at the request of the Department of Energy Headquarters and is not required as part of the annual National Emission Standards for Hazardous Air Pollutants reporting requirements (under 40 CFR Section 61.94).

REQUEST: Provide an estimate of the collective effective dose equivalent (person-rem per year) for 1998 releases.

An estimate of the collective effective dose equivalent (person-rem per year) will be provided in the *Idaho National Engineering and Environmental Laboratory Site Environmental Report for Calendar Year 1998 {DOE/ID-12082(98)}*. This collective EDE is calculated using the mesoscale diffusion (MDIFF) model and not CAP-88.

REQUEST: Provide information on the status of compliance with Subparts Q and T of 40 CFR Part 61 if pertinent.

Subpart Q of 40 CFR Part 61, National Emission Standards for Radon Emissions From Department of Energy Facilities, is not applicable to the Naval Reactors Facility. Subpart T of 40 CFR Part 61, National Emission Standards for Radon Emissions From the Disposal of Uranium Mill Tailings, is not applicable to the Naval Reactors Facility.

REQUEST: Provide information on radon-220 emissions from sources containing uranium-232 and thorium-232 where emissions potentially can exceed 0.1 millirem (1 microsievert) per year to the public or 10 percent of the non-radon dose to the public.

The Naval Reactors Facility does not have any sources of uranium-232 or thorium-232 emissions that potentially can exceed 0.1 millirem (1 microsievert) per year to the public or 10 percent of the non-radon dose to the public.

REQUEST: Provide information on non-disposal and non-storage sources of radon-222 emissions where emissions potentially can exceed 0.1 millirem (1 microsievert) per year to the public or 10 percent of the non-radon dose to the public.

The Naval Reactors Facility does not have any non-disposal or non-storage sources of Radon-222 emissions that potentially can exceed 0.1 millirem (1 microsievert) per year to the public or 10 percent of the non-radon dose to the public.

REQUEST: For the purpose of assessing facility compliance with the National Emission Standards for Hazardous Air Pollutants effluent monitoring requirements of Subpart H under Section 61.93(b), give the number of emission points subject to the continuous monitoring requirements, the number of these emission points that do not comply with the Section 61.93(b) requirements, and if possible, the cost for upgrades. Describe site periodic confirmatory measurement plans. Indicate the status of the quality assurance program described by Appendix B, Method 114.

The Naval Reactors Facility does not have any emission points that require continuous monitoring under Section 61.93(b).

Periodic confirmatory measurements were accomplished by calculating the maximum unabated emissions for radiological emission points at NRF to determine if continuous monitoring is required under Section 61.93. Periodic confirmatory measurements were also accomplished by use of calculations and samples to determine the actual emissions in 1998.

Though NRF does not require continuous monitoring, a quality assurance (QA) program is incorporated into the environmental monitoring program. The QA program includes equipment calibration, the use of blanks and known standards, and the annual review and validation of radioactive airborne emission data by independent peer reviewers.

APPENDIX B

INEEL Research Center Report

Compliance With 40 CFR 61.94 For The INEEL Research Center

40 CFR 61.94(a) Compliance with this standard is demonstrated by use of 40 CFR 61 Appendix E. A comparison of the January 1, 1996, inventory plus all receipts received during the calendar year with the Appendix E limits appears in Table B-1 (See section (b)(2)). This table shows the quantity of radioactive material possessed during the calendar year is less than the Appendix E limits.

40 CFR 61.94(b) In addition to paragraph (a), the annual report will include the following information:

40 CFR 61.94(b)(1) The name and location of the facility.

Idaho National Engineering and Environmental Laboratory (INEEL) Research Center (IRC) facilities are located on a partially developed 14.3-hectare (35.5-acre) plot on the north side of the City of Idaho Falls. Though programs and operations at the IRC are affiliated with the INEEL, the IRC is located within the city limits of Idaho Falls and is not contiguous with the INEEL site, whose nearest boundary is located approximately 22 miles west of Idaho Falls.

Facilities at the IRC include office, laboratory, and technical support buildings. The largest is a 3-story office building connected by an enclosed walkway to a 1-story laboratory building containing 66 laboratories. Other buildings at the IRC include the Research Office Building, Physics Building, Electric Vehicle Building, and Systems Analysis Facility.

40 CFR 61.94(b)(2) A list of the radioactive materials used at the facility.

See Table B-1.

40 CFR 61.94(b)(3) A description of the handling and processing that the radioactive materials undergo at the facility.

The laboratory/office building is principally an experimental research facility dedicated to a wide range of research areas, including industrial microbiology; geochemistry; materials characterization; welding; ceramics; thermal fluids behavior; materials testing; nondestructive evaluation of materials using a standard industrial x-ray device, x-ray diffusion, and x-ray fluorescence; analytical and environmental chemistry; and biotechnology. Sample analysis, including assay of biological samples for radioactive contamination, and other INEEL support functions are also conducted at IRC facilities.

Table B-1. 40 CFR 61 Appendix E Compliance Table.

Radionuclide	IRC Possession Quantity (Ci) Includes 1/1/98 Inventory Plus All Materials Received in CY 1998	Physical State of Inventory	Appendix E Possession Quantity Limit (Ci)
Ba-133	1.1E-06	Liquid/Powder	4.9E-02
C-14	8.4E-06	Liquid/Powder	2.9E+02
Cs-137	1.3E-09	Liquid/Powder	2.3E-02
H-3	5.2E-05	Liquid/Powder	1.5E+04
Ni-63	9.1E-07	Liquid/Powder	1.4E+02
P-32	8.4E-08	Liquid/Powder	1.7E+01
Pb-210	5.25-12	Liquid/Powder	5.5E-02
Pu-239	9.0E-10	Liquid/Powder	2.5E-03
S-35	8.3E-08	Liquid/Powder	7.5E+01
U-238	8.1E-07	Liquid/Powder	8.6E-03

40 CFR 61.94(b)(4) A list of the stacks or vents or other points where radioactive materials are released to the atmosphere.

Radiological releases from the IRC could arise from uncontrolled laboratory fumehoods within the facility. Exhaust from most of the fume hoods is released directly to the outside atmosphere via the heat recovery fan (HRF) system of the facility HVAC system. The HRF system exhausts to the outside via three vertical vents on the north side of the mechanical penthouse on top of the IRC laboratory building. Stack height of these vents is 7.6 m (25 ft). The exhausts from other fume hoods (not exhausted to the HRF) are released to the atmosphere via a 2.1-m (7.0-ft) stack above the roof or two 8.5 m (28 ft) stacks above the roof.

40 CFR 61.94(b)(5) A description of the effluent controls that are used on each stack, vent, or other release point and an estimate of the efficiency of each control device.

None. There is no effluent control equipment associated with any of the IRC's release points.

40 CFR 61.94(b)(6) Distances from the points of release to the nearest residence, school, business or office and the nearest farms producing vegetables, milk, and meat.

Consistent with 40 CFR 61 Appendix E no person lives within 10 meters of the IRC and no milk, meat, or vegetables are produced within 100 meters of the IRC.

40 CFR 61.94(b)(7) The values used for all other user-supplied input parameters for the computer models (e.g., meteorological data) and the source of these data.

Not applicable. 40 CFR 61 Appendix E used for compliance.

40 CFR 61.94(b)(8) A brief description of all construction and modifications that were completed in the calendar year for which the report is prepared, but for which the requirement to apply for approval to construct or modify was waived under § 61.96 and associated documentation developed by DOE to support the waiver.

None.

APPENDIX C

1998 Meteorology Data

For CAP-88 Computer Code

STAR File Format

This is a STability ARray (STAR) file. It shows the frequencies of occurrence that the wind is blowing FROM a particular direction, at a particular stability, at a particular speed. The frequencies are in x.xxxxx format, unspaced. The format is:

column 1	:	Blank
2-4	:	Wind Direction
5	:	Blank
6	:	Stability Category
7	:	Blank
8	:	Start of the Wind Speed Categories (knots)
8-14	:	Wind Speed 1–3 knots
15-21	:	Wind Speed 4–6 knots
22-28	:	Wind Speed 7–10 knots
29-35	:	Wind Speed 11–16 knots
36-42	:	Wind Speed 17–21 knots
43-49	:	Wind Speed >21 knots

Example:

```
  N A 0.000080.000660.000000.000000.000000.00000
NNE A 0.000160.000330.000000.000000.000000.00000
 NE A 0.000160.000160.000000.000000.000000.00000
ENE A 0.000080.000000.000000.000000.000000.00000
```

Table C-1. STAR File Used for ANL Ground Level Releases.

```
  N A 0.003090.004190.000000.000000.000000.00000
NNE A 0.002490.008030.000000.000000.000000.00000
 NE A 0.002020.006630.000000.000000.000000.00000
ENE A 0.001540.003840.000000.000000.000000.00000
  E A 0.000830.002910.000000.000000.000000.00000
ESE A 0.000590.003140.000000.000000.000000.00000
 SE A 0.000360.003260.000000.000000.000000.00000
SSE A 0.000480.003610.000000.000000.000000.00000
  S A 0.000830.004070.000000.000000.000000.00000
SSW A 0.000480.006280.000000.000000.000000.00000
 SW A 0.001190.005120.000000.000000.000000.00000
WSW A 0.001070.004770.000000.000000.000000.00000
  W A 0.001190.002910.000000.000000.000000.00000
WNW A 0.001900.002560.000000.000000.000000.00000
 NW A 0.001900.002210.000000.000000.000000.00000
NNW A 0.002020.003260.000000.000000.000000.00000
  N B 0.000230.002330.000470.000000.000000.00000
NNE B 0.000350.003840.000580.000000.000000.00000
 NE B 0.000580.003140.000810.000000.000000.00000
ENE B 0.000700.002330.001050.000000.000000.00000
  E B 0.000120.000580.000470.000000.000000.00000
ESE B 0.000000.000580.000230.000000.000000.00000
 SE B 0.000000.000580.001050.000000.000000.00000
SSE B 0.000000.001050.000470.000000.000000.00000
  S B 0.000120.001740.001740.000000.000000.00000
SSW B 0.000350.003260.001860.000000.000000.00000
 SW B 0.000120.001980.003260.000000.000000.00000
WSW B 0.000230.001860.001160.000000.000000.00000
  W B 0.000120.000580.001050.000000.000000.00000
WNW B 0.000230.000700.000930.000000.000000.00000
 NW B 0.000000.000930.000230.000000.000000.00000
NNW B 0.000230.000350.000580.000000.000000.00000
  N C 0.000000.001510.000810.000350.000000.00000
NNE C 0.000470.004300.002440.000000.000000.00000
 NE C 0.000470.005580.002680.000000.000000.00000
ENE C 0.000000.001740.001160.000000.000000.00000
  E C 0.000350.000120.000350.000120.000000.00000
ESE C 0.000230.000350.000810.000120.000000.00000
 SE C 0.000000.000350.000470.000120.000000.00000
SSE C 0.000000.000230.001400.000000.000000.00000
  S C 0.000120.000810.003840.000350.000000.00000
SSW C 0.000000.001160.006980.000810.000000.00000
 SW C 0.000000.001050.006170.000470.000000.00000
WSW C 0.000120.001280.001630.000350.000000.00000
  W C 0.000000.000810.000470.000120.000000.00000
WNW C 0.000120.000470.000580.000120.000000.00000
 NW C 0.000120.000580.001280.000120.000000.00000
NNW C 0.000000.000700.001050.000120.000000.00000
  N D 0.000810.006170.005120.005350.002210.00000
NNE D 0.001740.021750.013490.004770.002680.00116
 NE D 0.000810.022570.021170.006400.000470.00023
ENE D 0.001280.011520.007100.000230.000120.00000
  E D 0.000470.003840.003140.000470.000000.00000
ESE D 0.000700.001280.001860.000350.000000.00000
 SE D 0.000470.001740.002440.000470.000120.00000
SSE D 0.001050.006400.014540.006400.000000.00012
  S D 0.001050.008720.020940.021750.007210.00070
SSW D 0.000580.009190.026990.039200.017220.00361
 SW D 0.000470.006750.021410.032570.021410.01349
WSW D 0.000120.003370.007560.007330.004190.00279
  W D 0.000000.001160.001400.000580.000120.00012
WNW D 0.000230.001160.001980.000580.000000.00000
 NW D 0.000120.002680.002440.000930.000120.00000
NNW D 0.000810.002560.004420.002680.000350.00000
  N E 0.000590.003020.002330.000000.000000.00000
NNE E 0.001410.007330.004770.000000.000000.00000
 NE E 0.001300.012450.005470.000000.000000.00000
ENE E 0.001060.008840.005470.000000.000000.00000
  E E 0.000350.001980.001630.000000.000000.00000
ESE E 0.000470.001050.002090.000000.000000.00000
 SE E 0.000350.001400.003610.000000.000000.00000
SSE E 0.001180.008140.014310.000000.000000.00000
  S E 0.001060.008140.007330.000000.000000.00000
SSW E 0.000470.006050.008490.000000.000000.00000
 SW E 0.000240.003720.005230.000000.000000.00000
WSW E 0.000470.002560.002330.000000.000000.00000
  W E 0.000000.000810.000000.000000.000000.00000
WNW E 0.000000.000470.000350.000000.000000.00000
 NW E 0.000240.001160.000580.000000.000000.00000
NNW E 0.000470.001400.001980.000000.000000.00000
  N F 0.005240.005820.000000.000000.000000.00000
NNE F 0.008570.007100.000000.000000.000000.00000
 NE F 0.011070.008610.000000.000000.000000.00000
ENE F 0.008570.008380.000000.000000.000000.00000
  E F 0.007740.003370.000000.000000.000000.00000
ESE F 0.006310.004420.000000.000000.000000.00000
 SE F 0.008090.003260.000000.000000.000000.00000
SSE F 0.005950.005120.000000.000000.000000.00000
  S F 0.006190.006400.000000.000000.000000.00000
SSW F 0.006430.007560.000000.000000.000000.00000
 SW F 0.005000.005350.000000.000000.000000.00000
WSW F 0.004050.003490.000000.000000.000000.00000
  W F 0.003210.002910.000000.000000.000000.00000
WNW F 0.002740.002790.000000.000000.000000.00000
 NW F 0.002380.002090.000000.000000.000000.00000
NNW F 0.004760.004650.000000.000000.000000.00000
```

Table C-2. STAR File Used for ANL Elevated Releases.

```
  N A 0.001410.003380.000000.000000.000000.00000
NNE A 0.001530.005140.000000.000000.000000.00000
 NE A 0.001180.004550.000230.000000.000000.00000
ENE A 0.001290.003970.000120.000000.000000.00000
  E A 0.001290.003150.000120.000000.000000.00000
ESE A 0.000590.002220.000000.000000.000000.00000
 SE A 0.001060.003270.000000.000000.000000.00000
SSE A 0.000350.002570.000230.000000.000000.00000
  S A 0.000710.002800.000470.000000.000000.00000
SSW A 0.000000.004440.000470.000000.000000.00000
 SW A 0.001060.004200.000350.000000.000000.00000
WSW A 0.000820.002920.000230.000000.000000.00000
  W A 0.001410.003620.000120.000000.000000.00000
WNW A 0.000710.002570.000000.000000.000000.00000
 NW A 0.000940.002220.000000.000000.000000.00000
NNW A 0.001650.002570.000230.000000.000000.00000
  N B 0.000120.000930.000580.000000.000000.00000
NNE B 0.000470.001630.001050.000000.000000.00000
 NE B 0.000000.001630.001750.000000.000000.00000
ENE B 0.000230.000930.001980.000000.000000.00000
  E B 0.000120.000470.000580.000000.000000.00000
ESE B 0.000000.000350.000470.000000.000000.00000
 SE B 0.000000.000580.000580.000000.000000.00000
SSE B 0.000120.000470.001520.000000.000000.00000
  S B 0.000000.000820.002570.000000.000000.00000
SSW B 0.000120.001050.002920.000000.000000.00000
 SW B 0.000120.001280.003730.000000.000000.00000
WSW B 0.000000.001050.002100.000000.000000.00000
  W B 0.000000.000000.001050.000120.000000.00000
WNW B 0.000230.000580.000580.000000.000000.00000
 NW B 0.000000.000470.000820.000000.000000.00000
NNW B 0.000350.000120.000930.000000.000000.00000
  N C 0.000470.001050.000700.000820.000000.00000
NNE C 0.000470.004080.000470.000470.000000.00000
 NE C 0.000470.003030.001870.000350.000000.00000
ENE C 0.000120.001630.001170.000120.000000.00000
  E C 0.000120.000230.000700.000120.000000.00000
ESE C 0.000120.000120.000470.000350.000000.00000
 SE C 0.000000.000350.000580.000230.000000.00000
SSE C 0.000120.000700.000930.000580.000000.00000
  S C 0.000000.000230.002330.001400.000000.00000
SSW C 0.000120.001870.004080.002220.000120.00000
 SW C 0.000230.000350.003620.002570.000000.00000
WSW C 0.000000.000580.000930.000930.000120.00000
  W C 0.000120.000470.000700.000700.000000.00000
WNW C 0.000000.000350.000470.000580.000120.00000
 NW C 0.000000.000470.000120.000580.000000.00000
NNW C 0.000470.000580.000700.000350.000000.00000
  N D 0.000840.008170.005250.006070.005490.00152
NNE D 0.000600.015870.011320.005840.004550.00338
 NE D 0.000960.018440.028710.013310.005250.00163
ENE D 0.000000.004200.008170.002680.000230.00000
  E D 0.000000.001400.001750.001280.000350.00012
ESE D 0.000120.000580.000930.001170.000580.00000
 SE D 0.000000.001400.002100.000350.000350.00000
SSE D 0.000000.001630.002920.004320.003270.00023
  S D 0.000120.002220.006420.014120.016220.00980
SSW D 0.000240.003150.014240.024160.029410.02148
 SW D 0.000120.004550.013310.023460.029760.03758
WSW D 0.000360.003850.006650.007700.008750.01202
  W D 0.000000.001520.003150.001520.000820.00023
WNW D 0.000240.001400.001980.001630.000470.00012
 NW D 0.000240.002680.003620.001630.001170.00012
NNW D 0.000240.003620.002570.003730.002220.00023
  N E 0.000480.004200.005140.004080.002100.00000
NNE E 0.000960.008050.012490.008170.001980.00000
 NE E 0.000360.008400.015060.011670.004550.00023
ENE E 0.000360.003380.006190.003620.001280.00000
  E E 0.000120.000820.000930.000230.000230.00000
ESE E 0.000120.000700.001170.000820.000230.00000
 SE E 0.000240.000700.002220.000230.000000.00000
SSE E 0.000120.000470.003380.003970.001170.00000
  S E 0.000000.001750.003730.008870.001630.00000
SSW E 0.000360.001630.005250.009450.003270.00000
 SW E 0.000360.003270.004320.010970.004200.00000
WSW E 0.000120.002450.005250.006300.003500.00000
  W E 0.000000.001400.002330.001170.000000.00000
WNW E 0.000360.000700.001870.000930.000000.00000
 NW E 0.000000.001280.002450.000820.000470.00000
NNW E 0.000000.003150.003150.003380.000700.00000
  N F 0.001660.004790.002450.000120.000000.00000
NNE F 0.002130.004320.005840.002100.000230.00000
 NE F 0.002490.005600.005950.003270.000350.00000
ENE F 0.001890.002450.002100.000580.000000.00000
  E F 0.001780.002570.000470.000000.000000.00000
ESE F 0.002130.001870.000580.000000.000000.00000
 SE F 0.002010.001980.000350.000120.000000.00000
SSE F 0.001180.001400.000470.000230.000000.00000
  S F 0.000950.001750.000820.000230.000120.00000
SSW F 0.000360.002220.001050.000230.000000.00000
 SW F 0.000590.002450.001400.000120.000000.00000
WSW F 0.001070.002920.002450.001280.000120.00000
  W F 0.001420.004200.001400.000230.000000.00000
WNW F 0.001420.003500.000930.000120.000000.00000
 NW F 0.001660.004080.001520.000700.000000.00000
NNW F 0.001660.004080.002220.000350.000000.00000
```

Table C-3. STAR File Used for CFA (and RWMC) Ground Level Releases.

```
  N A 0.001790.003830.000000.000000.000000.00000
NNE A 0.002270.004180.000000.000000.000000.00000
 NE A 0.002620.006160.000000.000000.000000.00000
ENE A 0.002150.005460.000000.000000.000000.00000
  E A 0.001430.004180.000000.000000.000000.00000
ESE A 0.001670.003830.000000.000000.000000.00000
 SE A 0.001550.004880.000000.000000.000000.00000
SSE A 0.000950.004420.000000.000000.000000.00000
  S A 0.000950.005350.000000.000000.000000.00000
SSW A 0.001310.005460.000000.000000.000000.00000
 SW A 0.000360.005110.000000.000000.000000.00000
WSW A 0.000600.002670.000000.000000.000000.00000
  W A 0.000840.002090.000000.000000.000000.00000
WNW A 0.000240.001630.000000.000000.000000.00000
 NW A 0.001430.001980.000000.000000.000000.00000
NNW A 0.001790.002210.000000.000000.000000.00000
  N B 0.000700.000930.000350.000000.000000.00000
NNE B 0.000120.001860.000810.000000.000000.00000
 NE B 0.000230.002210.001860.000000.000000.00000
ENE B 0.000350.001510.001390.000000.000000.00000
  E B 0.000230.000700.000930.000000.000000.00000
ESE B 0.000120.000460.000230.000000.000000.00000
 SE B 0.000000.001050.000580.000000.000000.00000
SSE B 0.000000.001740.001280.000000.000000.00000
  S B 0.000120.001280.001860.000000.000000.00000
SSW B 0.000120.001980.002560.000000.000000.00000
 SW B 0.000000.002440.002560.000000.000000.00000
WSW B 0.000120.002210.001510.000000.000000.00000
  W B 0.000000.000810.000230.000000.000000.00000
WNW B 0.000000.000350.000350.000000.000000.00000
 NW B 0.000000.000120.000930.000000.000000.00000
NNW B 0.000120.000350.000580.000000.000000.00000
  N C 0.000130.000700.001630.000350.000000.00000
NNE C 0.000640.003600.001740.000120.000000.00000
 NE C 0.000760.004180.002910.000230.000000.00000
ENE C 0.000250.001160.002090.000120.000000.00000
  E C 0.000000.000580.000460.000000.000000.00000
ESE C 0.000250.000350.000700.000000.000000.00000
 SE C 0.000250.000460.001160.000120.000000.00000
SSE C 0.000000.000930.001740.000120.000000.00000
  S C 0.000000.001280.003490.000460.000000.00000
SSW C 0.000000.000810.005690.000700.000000.00000
 SW C 0.000000.000930.006510.000810.000000.00000
WSW C 0.000130.001980.002440.000460.000000.00000
  W C 0.000000.000350.002320.000580.000000.00000
WNW C 0.000000.000230.000580.000120.000000.00000
 NW C 0.000000.000000.000810.000000.000000.00000
NNW C 0.000000.000460.000580.000120.000000.00000
  N D 0.000950.009530.004420.004420.001050.00012
NNE D 0.000830.034630.025680.006390.001510.00070
 NE D 0.001060.017200.026610.011390.001510.00023
ENE D 0.000470.005110.004880.001980.000460.00012
  E D 0.000000.001280.000700.000000.000000.00000
ESE D 0.000120.000930.000460.000350.000000.00000
 SE D 0.000000.001630.001390.000700.000000.00000
SSE D 0.000120.003950.004420.001280.000230.00000
  S D 0.000120.005460.009300.005930.001510.00035
SSW D 0.000000.003600.013600.014530.002670.00012
 SW D 0.000240.006740.028010.048460.026840.01302
WSW D 0.000470.009650.028470.033590.018130.01255
  W D 0.000950.006280.010110.002670.000230.00000
WNW D 0.000710.003830.002560.001390.000460.00012
 NW D 0.000350.003140.001160.000810.000350.00000
NNW D 0.000240.003720.001390.000700.000120.00000
  N E 0.001410.008130.003020.000000.000000.00000
NNE E 0.000590.018710.012090.000000.000000.00000
 NE E 0.000590.009650.007210.000000.000000.00000
ENE E 0.000120.002560.003600.000000.000000.00000
  E E 0.000240.000350.000120.000000.000000.00000
ESE E 0.000000.001050.000460.000000.000000.00000
 SE E 0.000240.000580.001050.000000.000000.00000
SSE E 0.000120.002790.001160.000000.000000.00000
  S E 0.000120.003720.003830.000000.000000.00000
SSW E 0.000000.002560.003020.000000.000000.00000
 SW E 0.000940.004180.006860.000000.000000.00000
WSW E 0.001650.006970.011500.000000.000000.00000
  W E 0.000470.008130.003140.000000.000000.00000
WNW E 0.000590.003250.001280.000000.000000.00000
 NW E 0.000590.002790.000000.000000.000000.00000
NNW E 0.000820.003950.000580.000000.000000.00000
  N F 0.005880.009060.000000.000000.000000.00000
NNE F 0.005300.009300.000000.000000.000000.00000
 NE F 0.002940.006620.000000.000000.000000.00000
ENE F 0.002820.004420.000000.000000.000000.00000
  E F 0.002940.002320.000000.000000.000000.00000
ESE F 0.002940.001740.000000.000000.000000.00000
 SE F 0.002820.003490.000000.000000.000000.00000
SSE F 0.002940.004880.000000.000000.000000.00000
  S F 0.003650.004300.000000.000000.000000.00000
SSW F 0.003410.008370.000000.000000.000000.00000
 SW F 0.004350.008020.000000.000000.000000.00000
WSW F 0.003880.008830.000000.000000.000000.00000
  W F 0.005770.007790.000000.000000.000000.00000
WNW F 0.004940.006510.000000.000000.000000.00000
 NW F 0.004470.006970.000000.000000.000000.00000
NNW F 0.004710.008130.000000.000000.000000.00000
```

Table C-4. STAR File Used for INTEC Ground Level Releases.

N	A	0.001430.002980.000000.000000.000000.00000
NNE	A	0.002380.003790.000000.000000.000000.00000
NE	A	0.002020.005970.000000.000000.000000.00000
ENE	A	0.001660.007580.000000.000000.000000.00000
E	A	0.001900.003210.000000.000000.000000.00000
ESE	A	0.001070.005280.000000.000000.000000.00000
SE	A	0.001660.005050.000000.000000.000000.00000
SSE	A	0.002380.004940.000000.000000.000000.00000
S	A	0.001070.005050.000000.000000.000000.00000
SSW	A	0.001660.005740.000000.000000.000000.00000
SW	A	0.001070.004940.000000.000000.000000.00000
WSW	A	0.001070.003330.000000.000000.000000.00000
W	A	0.000830.002980.000000.000000.000000.00000
WNW	A	0.000830.001490.000000.000000.000000.00000
NW	A	0.000360.001150.000000.000000.000000.00000
NNW	A	0.001540.002640.000000.000000.000000.00000
N	B	0.000240.000920.000230.000000.000000.00000
NNE	B	0.000590.002530.000800.000000.000000.00000
NE	B	0.000710.003560.002530.000000.000000.00000
ENE	B	0.000590.002300.000920.000000.000000.00000
E	B	0.000120.000800.000340.000000.000000.00000
ESE	B	0.000120.000460.000570.000000.000000.00000
SE	B	0.000120.001260.000230.000000.000000.00000
SSE	B	0.000000.001950.001380.000000.000000.00000
S	B	0.000240.003210.001720.000000.000000.00000
SSW	B	0.000000.001720.002750.000000.000000.00000
SW	B	0.000240.002530.001490.000000.000000.00000
WSW	B	0.000000.000460.000570.000000.000000.00000
W	B	0.000120.000690.000570.000000.000000.00000
WNW	B	0.000000.000340.000230.000000.000000.00000
NW	B	0.000120.000340.000110.000000.000000.00000
NNW	B	0.000120.000690.000800.000000.000000.00000
N	C	0.000460.000920.001260.000110.000000.00000
NNE	C	0.000690.003210.001950.000000.000000.00000
NE	C	0.000920.005050.002870.000000.000000.00000
ENE	C	0.000570.002180.001720.000000.000000.00000
E	C	0.000230.000460.000460.000000.000000.00000
ESE	C	0.000000.000460.000570.000110.000000.00000
SE	C	0.000000.000110.000570.000110.000000.00000
SSE	C	0.000000.000800.001260.000460.000000.00000
S	C	0.000000.001030.002750.000340.000000.00000
SSW	C	0.000000.001950.006890.001260.000000.00000
SW	C	0.000000.001840.006660.000570.000000.00000
WSW	C	0.000000.000340.003440.000570.000000.00000
W	C	0.000000.000460.002300.000230.000000.00000
WNW	C	0.000000.000110.001030.000110.000000.00000
NW	C	0.000110.000000.001260.000110.000000.00000
NNW	C	0.000230.000460.001260.000000.000000.00000
N	D	0.002110.014120.005170.006200.000570.00011
NNE	D	0.001640.027660.025480.005510.001840.00023
NE	D	0.001290.023190.030990.009070.000800.00023
ENE	D	0.000230.006310.005850.001380.000340.00011
E	D	0.000120.001950.000570.000570.000000.00000
ESE	D	0.000120.000460.000460.000230.000000.00000
SE	D	0.000120.000230.000800.000690.000110.00000
SSE	D	0.000230.002070.002870.000800.000230.00000
S	D	0.000120.005740.007690.003790.001610.00023
SSW	D	0.000470.010330.015730.016990.002980.00000
SW	D	0.000590.013660.036960.048440.023880.01067
WSW	D	0.001170.009180.018600.018940.011250.00631
W	D	0.000230.003210.004820.003440.000690.00000
WNW	D	0.000120.000800.001380.001030.000230.00000
NW	D	0.000230.000460.000570.000570.000230.00000
NNW	D	0.001060.001950.001490.002410.000340.00000
N	E	0.002660.009990.002410.000000.000000.00000
NNE	E	0.001850.014460.008720.000000.000000.00000
NE	E	0.000930.010900.008490.000000.000000.00000
ENE	E	0.000580.004250.002640.000000.000000.00000
E	E	0.000230.000230.000340.000000.000000.00000
ESE	E	0.000000.000460.000340.000000.000000.00000
SE	E	0.000230.001610.000690.000000.000000.00000
SSE	E	0.000230.001610.001610.000000.000000.00000
S	E	0.001040.004130.002980.000000.000000.00000
SSW	E	0.000810.008490.005850.000000.000000.00000
SW	E	0.001160.009530.011820.000000.000000.00000
WSW	E	0.000350.008030.008150.000000.000000.00000
W	E	0.000350.002410.000920.000000.000000.00000
WNW	E	0.000460.001610.000110.000000.000000.00000
NW	E	0.000580.002180.000340.000000.000000.00000
NNW	E	0.001620.002300.000340.000000.000000.00000
N	F	0.007640.008490.000000.000000.000000.00000
NNE	F	0.007640.009640.000000.000000.000000.00000
NE	F	0.006230.009180.000000.000000.000000.00000
ENE	F	0.004700.004480.000000.000000.000000.00000
E	F	0.002470.003330.000000.000000.000000.00000
ESE	F	0.002120.002980.000000.000000.000000.00000
SE	F	0.002000.002980.000000.000000.000000.00000
SSE	F	0.002820.004130.000000.000000.000000.00000
S	F	0.006820.006200.000000.000000.000000.00000
SSW	F	0.006700.012050.000000.000000.000000.00000
SW	F	0.004000.010670.000000.000000.000000.00000
WSW	F	0.004820.008030.000000.000000.000000.00000
W	F	0.005170.006430.000000.000000.000000.00000
WNW	F	0.004230.004590.000000.000000.000000.00000
NW	F	0.005640.002750.000000.000000.000000.00000
NNW	F	0.007170.004710.000000.000000.000000.00000

Table C-5. STAR File Used for INTEC Elevated Releases.

```
  N A 0.001410.003380.000000.000000.000000.00000
NNE A 0.001530.005140.000000.000000.000000.00000
 NE A 0.001180.004550.000230.000000.000000.00000
ENE A 0.001290.003970.000120.000000.000000.00000
  E A 0.001290.003150.000120.000000.000000.00000
ESE A 0.000590.002220.000000.000000.000000.00000
 SE A 0.001060.003270.000000.000000.000000.00000
SSE A 0.000350.002570.000230.000000.000000.00000
  S A 0.000710.002800.000470.000000.000000.00000
SSW A 0.000000.004440.000470.000000.000000.00000
 SW A 0.001060.004200.000350.000000.000000.00000
WSW A 0.000820.002920.000230.000000.000000.00000
  W A 0.001410.003620.000120.000000.000000.00000
WNW A 0.000710.002570.000000.000000.000000.00000
 NW A 0.000940.002220.000000.000000.000000.00000
NNW A 0.001650.002570.000230.000000.000000.00000
  N B 0.000120.000930.000580.000000.000000.00000
NNE B 0.000470.001630.001050.000000.000000.00000
 NE B 0.000000.001630.001750.000000.000000.00000
ENE B 0.000230.000930.001980.000000.000000.00000
  E B 0.000120.000470.000580.000000.000000.00000
ESE B 0.000000.000350.000470.000000.000000.00000
 SE B 0.000000.000580.000580.000000.000000.00000
SSE B 0.000120.000470.001520.000000.000000.00000
  S B 0.000000.000820.002570.000000.000000.00000
SSW B 0.000120.001050.002920.000000.000000.00000
 SW B 0.000120.001280.003730.000000.000000.00000
WSW B 0.000000.001050.002100.000000.000000.00000
  W B 0.000000.000000.001050.000120.000000.00000
WNW B 0.000230.000580.000580.000000.000000.00000
 NW B 0.000000.000470.000820.000000.000000.00000
NNW B 0.000350.000120.000930.000000.000000.00000
  N C 0.000470.001050.000700.000820.000000.00000
NNE C 0.000470.004080.000470.000470.000000.00000
 NE C 0.000470.003030.001870.000350.000000.00000
ENE C 0.000120.001630.001170.000120.000000.00000
  E C 0.000120.000230.000700.000120.000000.00000
ESE C 0.000120.000120.000470.000350.000000.00000
 SE C 0.000000.000350.000580.000230.000000.00000
SSE C 0.000120.000700.000930.000580.000000.00000
  S C 0.000000.000230.002330.001400.000000.00000
SSW C 0.000120.001870.004080.002220.000120.00000
 SW C 0.000230.000350.003620.002570.000000.00000
WSW C 0.000000.000580.000930.000930.000120.00000
  W C 0.000120.000470.000700.000700.000000.00000
WNW C 0.000000.000350.000470.000580.000120.00000
 NW C 0.000000.000470.000120.000580.000000.00000
NNW C 0.000470.000580.000700.000350.000000.00000
  N D 0.000840.008170.005250.006070.005490.00152
NNE D 0.000600.015870.011320.005840.004550.00338
 NE D 0.000960.018440.028710.013310.005250.00163
ENE D 0.000000.004200.008170.002680.000230.00000
  E D 0.000000.001400.001750.001280.000350.00012
ESE D 0.000120.000580.000930.001170.000580.00000
 SE D 0.000000.001400.002100.000350.000350.00000
SSE D 0.000000.001630.002920.004320.003270.00023
  S D 0.000120.002220.006420.014120.016220.00980
SSW D 0.000240.003150.014240.024160.029410.02148
 SW D 0.000120.004550.013310.023460.029760.03758
WSW D 0.000360.003850.006650.007700.008750.01202
  W D 0.000000.001520.003150.001520.000820.00023
WNW D 0.000240.001400.001980.001630.000470.00012
 NW D 0.000240.002680.003620.001630.001170.00012
NNW D 0.000240.003620.002570.003730.002220.00023
  N E 0.000480.004200.005140.004080.002100.00000
NNE E 0.000960.008050.012490.008170.001980.00000
 NE E 0.000360.008400.015060.011670.004550.00023
ENE E 0.000360.003380.006190.003620.001280.00000
  E E 0.000120.000820.000930.000230.000230.00000
ESE E 0.000120.000700.001170.000820.000230.00000
 SE E 0.000240.000700.002220.000230.000000.00000
SSE E 0.000120.000470.003380.003970.001170.00000
  S E 0.000000.001750.003730.008870.001630.00000
SSW E 0.000360.001630.005250.009450.003270.00000
 SW E 0.000360.003270.004320.010970.004200.00000
WSW E 0.000120.002450.005250.006300.003500.00000
  W E 0.000000.001400.002330.001170.000000.00000
WNW E 0.000360.000700.001870.000930.000000.00000
 NW E 0.000000.001280.002450.000820.000470.00000
NNW E 0.000000.003150.003150.003380.000700.00000
  N F 0.001660.004790.002450.000120.000000.00000
NNE F 0.002130.004320.005840.002100.000230.00000
 NE F 0.002490.005600.005950.003270.000350.00000
ENE F 0.001890.002450.002100.000580.000000.00000
  E F 0.001780.002570.000470.000000.000000.00000
ESE F 0.002130.001870.000580.000000.000000.00000
 SE F 0.002010.001980.000350.000120.000000.00000
SSE F 0.001180.001400.000470.000230.000000.00000
  S F 0.000950.001750.000820.000230.000120.00000
SSW F 0.000360.002220.001050.000230.000000.00000
 SW F 0.000590.002450.001400.000120.000000.00000
WSW F 0.001070.002920.002450.001280.000120.00000
  W F 0.001420.004200.001400.000230.000000.00000
WNW F 0.001420.003500.000930.000120.000000.00000
 NW F 0.001660.004080.001520.000700.000000.00000
NNW F 0.001660.004080.002220.000350.000000.00000
```

Table C-6. STAR File Used for NRF Ground Level Releases.

N	A	0.002250.003230.000000.000000.000000.00000
NNE	A	0.002720.004730.000000.000000.000000.00000
NE	A	0.002840.007260.000000.000000.000000.00000
ENE	A	0.001300.007260.000000.000000.000000.00000
E	A	0.002250.004490.000000.000000.000000.00000
ESE	A	0.002010.005190.000000.000000.000000.00000
SE	A	0.000950.003570.000000.000000.000000.00000
SSE	A	0.002010.006680.000000.000000.000000.00000
S	A	0.000710.005880.000000.000000.000000.00000
SSW	A	0.001420.004960.000000.000000.000000.00000
SW	A	0.000950.002880.000000.000000.000000.00000
WSW	A	0.001300.003690.000000.000000.000000.00000
W	A	0.001060.002650.000000.000000.000000.00000
WNW	A	0.001540.001840.000000.000000.000000.00000
NW	A	0.001420.001380.000000.000000.000000.00000
NNW	A	0.001180.002420.000000.000000.000000.00000
N	B	0.000000.001380.000920.000000.000000.00000
NNE	B	0.000240.001960.001380.000000.000000.00000
NE	B	0.000480.004260.001040.000000.000000.00000
ENE	B	0.000120.004260.001380.000000.000000.00000
E	B	0.000000.000460.000580.000000.000000.00000
ESE	B	0.000120.000920.000350.000000.000000.00000
SE	B	0.000240.001150.000920.000000.000000.00000
SSE	B	0.000240.001380.000810.000000.000000.00000
S	B	0.000240.004030.002880.000000.000000.00000
SSW	B	0.000120.001730.003000.000000.000000.00000
SW	B	0.000480.002540.002190.000000.000000.00000
WSW	B	0.000000.000810.001150.000000.000000.00000
W	B	0.000000.000230.001380.000000.000000.00000
WNW	B	0.000120.000580.000350.000000.000000.00000
NW	B	0.000000.000460.000460.000000.000000.00000
NNW	B	0.000360.001150.000580.000000.000000.00000
N	C	0.001000.001150.001730.000580.000000.00000
NNE	C	0.000370.003460.003000.000230.000000.00000
NE	C	0.001120.005420.002880.000120.000000.00000
ENE	C	0.000370.002540.002070.000120.000000.00000
E	C	0.000000.000690.000350.000000.000000.00000
ESE	C	0.000120.000350.000690.000000.000000.00000
SE	C	0.000000.000460.000230.000000.000000.00000
SSE	C	0.000370.000350.001150.000230.000000.00000
S	C	0.000370.001610.003570.000580.000000.00000
SSW	C	0.000120.001610.007950.000690.000000.00000
SW	C	0.000120.001380.005650.001040.000000.00000
WSW	C	0.000000.000120.002770.000230.000000.00000
W	C	0.000000.000000.001380.000000.000000.00000
WNW	C	0.000000.000120.000810.000000.000000.00000
NW	C	0.000120.000230.000920.000000.000000.00000
NNW	C	0.000000.000580.000920.000000.000000.00000
N	D	0.001530.007380.007610.004610.000920.00023
NNE	D	0.001650.020050.022130.006220.001730.00012
NE	D	0.001150.025580.038150.006450.000810.00012
ENE	D	0.000250.008640.008300.001840.000230.00012
E	D	0.000250.001380.001150.000230.000000.00000
ESE	D	0.000000.000460.001270.000460.000000.00000
SE	D	0.000250.001270.001500.000350.000120.00000
SSE	D	0.000510.002650.003340.001150.000230.00012
S	D	0.001150.006570.013020.007260.002190.00035
SSW	D	0.001150.012680.030190.028010.010600.00184
SW	D	0.001530.008760.031810.039530.027540.01521
WSW	D	0.000130.002650.007260.009680.003920.00207
W	D	0.000000.001610.001380.000920.000230.00000
WNW	D	0.000000.000350.000920.000690.000230.00000
NW	D	0.000250.000920.002070.002420.000230.00012
NNW	D	0.001150.002540.005420.014180.005880.00069
N	E	0.001510.004960.002420.000000.000000.00000
NNE	E	0.001160.007610.006220.000000.000000.00000
NE	E	0.001050.012790.013250.000000.000000.00000
ENE	E	0.000470.006450.004260.000000.000000.00000
E	E	0.000580.003000.000350.000000.000000.00000
ESE	E	0.000230.001150.000460.000000.000000.00000
SE	E	0.000000.001380.000230.000000.000000.00000
SSE	E	0.000230.001380.001270.000000.000000.00000
S	E	0.000930.006340.004030.000000.000000.00000
SSW	E	0.001510.008070.008870.000000.000000.00000
SW	E	0.000930.006110.010720.000000.000000.00000
WSW	E	0.000230.002880.002190.000000.000000.00000
W	E	0.000120.001610.000350.000000.000000.00000
WNW	E	0.000120.000580.000000.000000.000000.00000
NW	E	0.000120.000920.001610.000000.000000.00000
NNW	E	0.001510.002300.001500.000000.000000.00000
N	F	0.006020.006340.000000.000000.000000.00000
NNE	F	0.006980.009220.000000.000000.000000.00000
NE	F	0.006620.010140.000000.000000.000000.00000
ENE	F	0.006980.006110.000000.000000.000000.00000
E	F	0.004930.006220.000000.000000.000000.00000
ESE	F	0.004930.003690.000000.000000.000000.00000
SE	F	0.003490.004150.000000.000000.000000.00000
SSE	F	0.003610.005880.000000.000000.000000.00000
S	F	0.004570.006450.000000.000000.000000.00000
SSW	F	0.006740.005880.000000.000000.000000.00000
SW	F	0.004690.006340.000000.000000.000000.00000
WSW	F	0.004450.003690.000000.000000.000000.00000
W	F	0.005290.002540.000000.000000.000000.00000
WNW	F	0.002650.002420.000000.000000.000000.00000
NW	F	0.004090.002770.000000.000000.000000.00000
NNW	F	0.004810.003460.000000.000000.000000.00000

Table C-7. STAR File Used for PBF Ground Level Releases.

```
  N A 0.002650.003440.000000.000000.000000.00000
NNE A 0.001730.004710.000000.000000.000000.00000
 NE A 0.001730.006540.000000.000000.000000.00000
ENE A 0.000920.004940.000000.000000.000000.00000
  E A 0.000580.003330.000000.000000.000000.00000
ESE A 0.000920.002870.000000.000000.000000.00000
 SE A 0.000690.002640.000000.000000.000000.00000
SSE A 0.001040.004130.000000.000000.000000.00000
  S A 0.001380.004590.000000.000000.000000.00000
SSW A 0.001150.004710.000000.000000.000000.00000
 SW A 0.002080.003440.000000.000000.000000.00000
WSW A 0.001730.002530.000000.000000.000000.00000
  W A 0.001610.004020.000000.000000.000000.00000
WNW A 0.001500.001950.000000.000000.000000.00000
 NW A 0.001850.001720.000000.000000.000000.00000
NNW A 0.001730.003790.000000.000000.000000.00000
  N B 0.000120.001260.000920.000000.000000.00000
NNE B 0.000610.002980.000460.000000.000000.00000
 NE B 0.000000.003210.001720.000000.000000.00000
ENE B 0.000000.001950.000920.000000.000000.00000
  E B 0.000000.000690.000570.000000.000000.00000
ESE B 0.000000.000800.000340.000000.000000.00000
 SE B 0.000000.000340.000800.000000.000000.00000
SSE B 0.000000.001260.001720.000000.000000.00000
  S B 0.000250.003900.002980.000000.000000.00000
SSW B 0.000250.004590.002750.000000.000000.00000
 SW B 0.000000.001950.002410.000000.000000.00000
WSW B 0.000000.000920.001150.000000.000000.00000
  W B 0.000120.000800.000460.000000.000000.00000
WNW B 0.000000.000110.000570.000000.000000.00000
 NW B 0.000120.001030.000110.000000.000000.00000
NNW B 0.000120.001030.000340.000000.000000.00000
  N C 0.000130.001490.001260.000340.000000.00000
NNE C 0.000130.004710.002980.000230.000000.00000
 NE C 0.000260.002180.002750.000000.000000.00000
ENE C 0.000000.000460.000570.000000.000000.00000
  E C 0.000000.000110.001150.000000.000000.00000
ESE C 0.000000.000230.000460.000110.000000.00000
 SE C 0.000000.000110.000340.000110.000000.00000
SSE C 0.000000.000570.002180.000460.000000.00000
  S C 0.000130.001610.005050.000800.000000.00000
SSW C 0.000640.001380.005280.000920.000000.00000
 SW C 0.000000.001610.007690.001030.000000.00000
WSW C 0.000130.000570.003440.000230.000000.00000
  W C 0.000260.000800.000920.000230.000000.00000
WNW C 0.000000.000000.000800.000230.000000.00000
 NW C 0.000130.000000.000800.000230.000000.00000
NNW C 0.000260.001030.001380.000000.000000.00000
  N D 0.000470.006430.004710.005620.001490.00023
NNE D 0.001660.022610.029730.012740.002530.00126
 NE D 0.000470.022380.033520.016070.001260.00034
ENE D 0.000120.008950.009530.002870.000230.00000
  E D 0.000120.002410.002070.000460.000000.00000
ESE D 0.000000.001030.000800.000230.000000.00000
 SE D 0.000120.001260.004020.001720.000110.00000
SSE D 0.000000.004480.010330.004940.000340.00023
  S D 0.000830.008380.016180.012860.003900.00046
SSW D 0.000950.008840.018140.020780.008950.00069
 SW D 0.000710.004590.018940.036850.026630.01607
WSW D 0.000120.003790.013310.016070.010100.00562
  W D 0.000360.001380.001610.002530.000110.00011
WNW D 0.000360.000690.001380.000570.000340.00023
 NW D 0.000360.000340.001030.000690.000000.00000
NNW D 0.000360.001840.001720.002180.001840.00011
  N E 0.000350.003560.001150.000000.000000.00000
NNE E 0.001050.010220.005740.000000.000000.00000
 NE E 0.000580.012970.011250.000000.000000.00000
ENE E 0.000460.007000.008260.000000.000000.00000
  E E 0.000230.001380.001030.000000.000000.00000
ESE E 0.000120.000460.000230.000000.000000.00000
 SE E 0.000350.000920.001380.000000.000000.00000
SSE E 0.000930.003900.007230.000000.000000.00000
  S E 0.001160.005390.003900.000000.000000.00000
SSW E 0.001390.005390.004020.000000.000000.00000
 SW E 0.001390.003440.005390.000000.000000.00000
WSW E 0.000580.002530.002300.000000.000000.00000
  W E 0.000460.000690.000690.000000.000000.00000
WNW E 0.000000.000340.000460.000000.000000.00000
 NW E 0.000460.001490.000110.000000.000000.00000
NNW E 0.000230.001610.000230.000000.000000.00000
  N F 0.008640.007230.000000.000000.000000.00000
NNE F 0.006600.011480.000000.000000.000000.00000
 NE F 0.006000.012630.000000.000000.000000.00000
ENE F 0.004080.008260.000000.000000.000000.00000
  E F 0.004560.003100.000000.000000.000000.00000
ESE F 0.002280.003330.000000.000000.000000.00000
 SE F 0.003000.002750.000000.000000.000000.00000
SSE F 0.005400.005510.000000.000000.000000.00000
  S F 0.007800.007920.000000.000000.000000.00000
SSW F 0.010070.008490.000000.000000.000000.00000
 SW F 0.007080.007350.000000.000000.000000.00000
WSW F 0.007080.005280.000000.000000.000000.00000
  W F 0.005880.003210.000000.000000.000000.00000
WNW F 0.005760.003560.000000.000000.000000.00000
 NW F 0.006000.002980.000000.000000.000000.00000
NNW F 0.004320.003560.000000.000000.000000.00000
```

Table C-8. STAR File Used for TAN Ground Level Releases.

N	A	0.001900.002070.000000.000000.000000.00000
NNE	A	0.002370.005050.000000.000000.000000.00000
NE	A	0.002840.008840.000000.000000.000000.00000
ENE	A	0.003080.010440.000000.000000.000000.00000
E	A	0.003550.009410.000000.000000.000000.00000
ESE	A	0.002250.009290.000000.000000.000000.00000
SE	A	0.002130.007920.000000.000000.000000.00000
SSE	A	0.001540.008380.000000.000000.000000.00000
S	A	0.002130.007800.000000.000000.000000.00000
SSW	A	0.002130.006540.000000.000000.000000.00000
SW	A	0.002010.003560.000000.000000.000000.00000
WSW	A	0.001660.001030.000000.000000.000000.00000
W	A	0.001660.002070.000000.000000.000000.00000
WNW	A	0.000590.001490.000000.000000.000000.00000
NW	A	0.001180.001840.000000.000000.000000.00000
NNW	A	0.000710.001260.000000.000000.000000.00000
N	B	0.000000.001610.000800.000000.000000.00000
NNE	B	0.000230.001950.000570.000000.000000.00000
NE	B	0.000460.004480.001260.000000.000000.00000
ENE	B	0.000110.005050.001260.000000.000000.00000
E	B	0.000110.003670.001950.000000.000000.00000
ESE	B	0.000230.001720.001150.000000.000000.00000
SE	B	0.000110.001490.000800.000000.000000.00000
SSE	B	0.000000.002520.000340.000000.000000.00000
S	B	0.000110.003330.001610.000000.000000.00000
SSW	B	0.000110.003790.002290.000000.000000.00000
SW	B	0.000000.002520.002070.000000.000000.00000
WSW	B	0.000000.000690.001030.000000.000000.00000
W	B	0.000000.000340.000460.000000.000000.00000
WNW	B	0.000110.000920.000570.000000.000000.00000
NW	B	0.000230.000800.000690.000000.000000.00000
NNW	B	0.000230.000690.000800.000000.000000.00000
N	C	0.000000.000800.003100.000110.000000.00000
NNE	C	0.000110.004250.001610.000230.000000.00000
NE	C	0.000920.008610.003560.000460.000000.00000
ENE	C	0.000570.005390.002180.000110.000000.00000
E	C	0.001030.001490.001030.000230.000000.00000
ESE	C	0.000000.000460.000460.000110.000000.00000
SE	C	0.000230.000800.000690.000000.000000.00000
SSE	C	0.000000.000570.000800.000110.000000.00000
S	C	0.000000.001030.002410.000340.000000.00000
SSW	C	0.000000.001490.006880.000230.000000.00000
SW	C	0.000460.001490.005970.000570.000000.00000
WSW	C	0.000230.000110.002520.000340.000000.00000
W	C	0.000000.000110.001150.000000.000000.00000
WNW	C	0.000000.000000.000690.000000.000000.00000
NW	C	0.000230.000000.001380.000230.000000.00000
NNW	C	0.000000.000000.000920.000340.000000.00000
N	D	0.001030.040280.015380.007460.001950.00034
NNE	D	0.001030.025010.017560.003100.000460.00000
NE	D	0.001260.024780.021690.002640.000230.00000
ENE	D	0.001380.007340.003670.000460.000110.00000
E	D	0.000340.001840.001260.000230.000000.00000
ESE	D	0.000110.000920.000690.000230.000000.00000
SE	D	0.000230.001720.000460.000690.000000.00000
SSE	D	0.000000.001490.001610.001260.000230.00011
S	D	0.000000.002180.007920.003440.000110.00000
SSW	D	0.000000.007110.015150.015260.003900.00046
SW	D	0.001380.006430.013880.023290.017560.00918
WSW	D	0.000110.001840.002870.003210.001840.00046
W	D	0.000110.000690.001610.000230.000110.00000
WNW	D	0.000000.000230.001030.001030.000000.00011
NW	D	0.000340.002070.003100.003900.001150.00011
NNW	D	0.001150.014920.010210.022720.024560.00998
N	E	0.000930.022490.004820.000000.000000.00000
NNE	E	0.000930.016180.005970.000000.000000.00000
NE	E	0.000930.008720.004250.000000.000000.00000
ENE	E	0.000350.002980.000110.000000.000000.00000
E	E	0.000460.001610.000110.000000.000000.00000
ESE	E	0.000000.000570.000230.000000.000000.00000
SE	E	0.000000.000570.000000.000000.000000.00000
SSE	E	0.000120.000460.000920.000000.000000.00000
S	E	0.000230.002180.003560.000000.000000.00000
SSW	E	0.000580.004360.004360.000000.000000.00000
SW	E	0.001390.004020.004480.000000.000000.00000
WSW	E	0.000580.000920.000460.000000.000000.00000
W	E	0.000120.000690.000110.000000.000000.00000
WNW	E	0.000230.001490.000230.000000.000000.00000
NW	E	0.000810.003330.000800.000000.000000.00000
NNW	E	0.002090.019620.012850.000000.000000.00000
N	F	0.009780.016750.000000.000000.000000.00000
NNE	F	0.008150.015950.000000.000000.000000.00000
NE	F	0.007220.009290.000000.000000.000000.00000
ENE	F	0.003960.005740.000000.000000.000000.00000
E	F	0.004430.003440.000000.000000.000000.00000
ESE	F	0.002450.002750.000000.000000.000000.00000
SE	F	0.002100.001150.000000.000000.000000.00000
SSE	F	0.003260.003210.000000.000000.000000.00000
S	F	0.002910.002520.000000.000000.000000.00000
SSW	F	0.003840.004250.000000.000000.000000.00000
SW	F	0.005240.003670.000000.000000.000000.00000
WSW	F	0.005590.004360.000000.000000.000000.00000
W	F	0.004890.004360.000000.000000.000000.00000
WNW	F	0.005710.003900.000000.000000.000000.00000
NW	F	0.006520.007920.000000.000000.000000.00000
NNW	F	0.008150.012280.000000.000000.000000.00000

Table C-9. STAR File Used for TAN Elevated Releases.

```
  N A 0.001880.002070.000000.000000.000000.00000
NNE A 0.001880.004030.000350.000000.000000.00000
 NE A 0.002590.005980.000000.000000.000000.00000
ENE A 0.002590.008630.000000.000000.000000.00000
  E A 0.002470.007020.000000.000000.000000.00000
ESE A 0.001880.007480.000230.000000.000000.00000
 SE A 0.002000.007480.000120.000000.000000.00000
SSE A 0.001180.008280.000120.000000.000000.00000
  S A 0.001410.005870.000230.000000.000000.00000
SSW A 0.000710.004950.000690.000000.000000.00000
 SW A 0.001290.003220.000230.000000.000000.00000
WSW A 0.000940.000690.000000.000000.000000.00000
  W A 0.000940.002190.000000.000000.000000.00000
WNW A 0.001060.001380.000120.000000.000000.00000
 NW A 0.000940.001500.000000.000000.000000.00000
NNW A 0.000940.001840.000120.000000.000000.00000
  N B 0.000000.001150.000690.000000.000000.00000
NNE B 0.000730.002190.000920.000000.000000.00000
 NE B 0.000240.003570.001730.000000.000000.00000
ENE B 0.000490.004030.002530.000000.000000.00000
  E B 0.000610.002070.002420.000000.000000.00000
ESE B 0.000120.000920.001150.000000.000000.00000
 SE B 0.000240.000580.001840.000000.000000.00000
SSE B 0.000000.001150.001380.000000.000000.00000
  S B 0.000240.000920.003680.000000.000000.00000
SSW B 0.000240.001040.003800.000000.000000.00000
 SW B 0.000120.000350.003110.000000.000000.00000
WSW B 0.000000.000350.001270.000000.000000.00000
  W B 0.000000.000120.000690.000000.000000.00000
WNW B 0.000240.000580.001150.000000.000000.00000
 NW B 0.000120.000350.000580.000000.000000.00000
NNW B 0.000120.000230.001150.000000.000000.00000
  N C 0.000490.000920.002190.000810.000000.00000
NNE C 0.000610.004600.001840.000580.000000.00000
 NE C 0.000610.005290.002760.001150.000000.00000
ENE C 0.000000.005060.001610.000580.000000.00000
  E C 0.000240.002190.001270.000230.000000.00000
ESE C 0.000120.000920.000350.000460.000000.00000
 SE C 0.000120.000580.000460.000230.000000.00000
SSE C 0.000000.000690.000810.000460.000000.00000
  S C 0.000370.000810.002070.001270.000000.00000
SSW C 0.000120.002420.002760.003220.000000.00000
 SW C 0.000120.001150.002650.003110.000000.00000
WSW C 0.000240.000230.000690.001730.000000.00000
  W C 0.000120.000120.000120.000690.000000.00000
WNW C 0.000240.000120.000460.000350.000000.00000
 NW C 0.000000.000120.001040.000810.000000.00000
NNW C 0.000240.000000.001270.000350.000000.00000
  N D 0.000810.013230.025760.011500.002880.00104
NNE D 0.000920.022540.032320.008630.001150.00023
 NE D 0.001150.022430.025880.005290.000920.00000
ENE D 0.000460.008170.004950.000690.000350.00000
  E D 0.000120.002650.001270.001270.000000.00000
ESE D 0.000000.000920.000810.000920.000000.00000
 SE D 0.000000.000810.000580.000920.000120.00000
SSE D 0.000000.000350.001380.000810.001040.00023
  S D 0.000350.001150.004030.004950.002650.00069
SSW D 0.000810.003570.010700.015070.015760.01507
 SW D 0.000810.002880.005870.012080.015410.02208
WSW D 0.000580.000690.002190.002990.002760.00115
  W D 0.000000.000350.001270.000810.000350.00000
WNW D 0.000000.000460.001150.000690.000460.00012
 NW D 0.000920.001840.002880.005520.003220.00161
NNW D 0.001150.006670.008740.011040.020930.03128
  N E 0.001520.013110.017370.002990.000120.00000
NNE E 0.000820.014610.036460.007020.000000.00000
 NE E 0.000580.004600.009200.001380.000000.00000
ENE E 0.000230.002420.000690.000120.000000.00000
  E E 0.000120.001380.000350.000120.000000.00000
ESE E 0.000000.000000.000460.000000.000000.00000
 SE E 0.000120.000350.000460.000120.000000.00000
SSE E 0.000000.000350.000230.000690.000000.00000
  S E 0.000470.000460.002420.004260.000120.00000
SSW E 0.000470.000810.002760.008280.001610.00000
 SW E 0.000580.002530.002990.003570.000230.00000
WSW E 0.000230.000690.001150.000230.000000.00000
  W E 0.000000.000460.000690.000000.000000.00000
WNW E 0.000350.000350.000810.000000.000000.00000
 NW E 0.000930.002990.001960.000460.000000.00000
NNW E 0.001170.006100.009090.008400.000920.00000
  N F 0.006060.009090.004370.000230.000000.00000
NNE F 0.003030.011040.006790.000350.000000.00000
 NE F 0.002790.008740.002530.000120.000000.00000
ENE F 0.002180.004140.000690.000000.000000.00000
  E F 0.001700.003110.000460.000000.000000.00000
ESE F 0.001330.001730.000810.000000.000000.00000
 SE F 0.001330.001380.000690.000000.000000.00000
SSE F 0.001820.000920.000460.000000.000000.00000
  S F 0.002060.002190.000690.000120.000000.00000
SSW F 0.001820.002880.001840.000460.000000.00000
 SW F 0.002540.003340.001150.000000.000000.00000
WSW F 0.002660.002530.001040.000000.000000.00000
  W F 0.005090.003340.000230.000000.000000.00000
WNW F 0.003270.002880.000460.000000.000000.00000
 NW F 0.004000.005750.001380.000000.000000.00000
NNW F 0.003630.006900.003910.000690.000000.00000
```

Table C-10. STAR File Used for TRA Ground Level and Elevated Releases.

N	A	0.001640.003130.000000.000000.000000.00000
NNE	A	0.001290.003710.000000.000000.000000.00000
NE	A	0.002230.004640.000000.000000.000000.00000
ENE	A	0.001640.007310.000000.000000.000000.00000
E	A	0.003050.006960.000000.000000.000000.00000
ESE	A	0.001060.004760.000000.000000.000000.00000
SE	A	0.001410.004520.000000.000000.000000.00000
SSE	A	0.001290.005220.000000.000000.000000.00000
S	A	0.000700.005450.000000.000000.000000.00000
SSW	A	0.001640.005920.000000.000000.000000.00000
SW	A	0.000940.003710.000000.000000.000000.00000
WSW	A	0.000470.001970.000000.000000.000000.00000
W	A	0.000590.001970.000000.000000.000000.00000
WNW	A	0.000700.001620.000000.000000.000000.00000
NW	A	0.000940.001390.000000.000000.000000.00000
NNW	A	0.001060.001510.000000.000000.000000.00000
N	B	0.000250.000930.000230.000000.000000.00000
NNE	B	0.000490.001510.000930.000000.000000.00000
NE	B	0.000490.003020.001040.000000.000000.00000
ENE	B	0.000490.004290.002090.000000.000000.00000
E	B	0.000370.002780.000700.000000.000000.00000
ESE	B	0.000620.001160.000460.000000.000000.00000
SE	B	0.000000.001860.000460.000000.000000.00000
SSE	B	0.000000.001860.001280.000000.000000.00000
S	B	0.000250.000810.001160.000000.000000.00000
SSW	B	0.000250.003130.003480.000000.000000.00000
SW	B	0.000000.002440.001860.000000.000000.00000
WSW	B	0.000000.001280.001160.000000.000000.00000
W	B	0.000000.000460.000350.000000.000000.00000
WNW	B	0.000250.000000.000580.000000.000000.00000
NW	B	0.000000.000350.000700.000000.000000.00000
NNW	B	0.000120.000460.001040.000000.000000.00000
N	C	0.000230.000930.001280.000230.000000.00000
NNE	C	0.000460.002670.001740.000230.000000.00000
NE	C	0.000460.002900.003250.000000.000000.00000
ENE	C	0.000810.004060.002780.000000.000000.00000
E	C	0.000810.001390.001510.000000.000000.00000
ESE	C	0.000000.000350.000460.000120.000000.00000
SE	C	0.000000.000120.000350.000120.000000.00000
SSE	C	0.000000.000350.001160.000580.000000.00000
S	C	0.000120.000580.002440.000460.000000.00000
SSW	C	0.000000.001620.004870.000810.000000.00000
SW	C	0.000120.002090.009050.001160.000000.00000
WSW	C	0.000000.000350.003360.000460.000000.00000
W	C	0.000000.000230.001860.000230.000000.00000
WNW	C	0.000120.000120.000700.000120.000000.00000
NW	C	0.000120.000120.000810.000000.000000.00000
NNW	C	0.000000.000230.000460.000230.000000.00000
N	D	0.001060.007540.004990.003940.002780.00046
NNE	D	0.001890.019490.018210.007080.001510.00023
NE	D	0.000470.020880.035490.009160.001280.00023
ENE	D	0.000240.010790.013570.003710.000000.00000
E	D	0.000000.003600.001860.000350.000000.00000
ESE	D	0.000120.001160.000580.000580.000000.00000
SE	D	0.000120.001280.001280.000000.000000.00000
SSE	D	0.000120.001970.002090.001860.000230.00000
S	D	0.000240.003830.006840.003360.001740.00023
SSW	D	0.000710.008240.017750.017520.004640.00012
SW	D	0.000470.012880.038280.055330.024820.01148
WSW	D	0.000350.008240.025400.024590.012990.00870
W	D	0.000240.004640.007770.004760.000700.00023
WNW	D	0.000120.001390.001280.001390.000350.00012
NW	D	0.000350.000580.001860.001510.000120.00000
NNW	D	0.000470.002200.001510.000580.000580.00000
N	E	0.001650.005680.001620.000000.000000.00000
NNE	E	0.001410.011370.007540.000000.000000.00000
NE	E	0.000470.014270.010670.000000.000000.00000
ENE	E	0.000240.005450.003250.000000.000000.00000
E	E	0.000240.001040.000810.000000.000000.00000
ESE	E	0.000120.000700.000350.000000.000000.00000
SE	E	0.000120.000930.000700.000000.000000.00000
SSE	E	0.000000.000810.001040.000000.000000.00000
S	E	0.000470.002670.003020.000000.000000.00000
SSW	E	0.000350.005570.005920.000000.000000.00000
SW	E	0.000590.007310.010320.000000.000000.00000
WSW	E	0.000940.006500.008350.000000.000000.00000
W	E	0.000240.002780.003130.000000.000000.00000
WNW	E	0.000120.001620.001390.000000.000000.00000
NW	E	0.000590.001510.000000.000000.000000.00000
NNW	E	0.001180.002780.000230.000000.000000.00000
N	F	0.007150.008120.000000.000000.000000.00000
NNE	F	0.005840.009740.000000.000000.000000.00000
NE	F	0.005360.008470.000000.000000.000000.00000
ENE	F	0.003810.005920.000000.000000.000000.00000
E	F	0.003450.003250.000000.000000.000000.00000
ESE	F	0.002020.001970.000000.000000.000000.00000
SE	F	0.002740.003020.000000.000000.000000.00000
SSE	F	0.003570.003250.000000.000000.000000.00000
S	F	0.004170.004990.000000.000000.000000.00000
SSW	F	0.004170.008240.000000.000000.000000.00000
SW	F	0.003810.009280.000000.000000.000000.00000
WSW	F	0.004290.008000.000000.000000.000000.00000
W	F	0.003690.006500.000000.000000.000000.00000
WNW	F	0.004050.004410.000000.000000.000000.00000
NW	F	0.004880.004640.000000.000000.000000.00000
NNW	F	0.006190.004760.000000.000000.000000.00000

APPENDIX D

Input Parameter Values

For CAP-88 Computer Code

Table D-1. Input Parameter Values For CAP-88 Computer Code

RADIONUCLIDE-INDEPENDENT PARAMETERS	VALUE	REFERENCE
TIME DELAY--INGESTION OF LEAFY VEGETABLES BY MAN (HR)	24.0	NRC (1977)
TIME DELAY--INGESTION OF PRODUCE BY MAN (HR)	1,440.0	NRC (1977)
AGRICULTURAL PRODUCTIVITY BY UNIT AREA (PRODUCE OR LEAFY VEG INGESTED BY MAN (KG/SQ METER))	2.0	NRC (1977)
RATE OF INGESTION OF PRODUCE BY MAN (KG/YR)	520.0	NRC (1977)
RATE OF INGESTION OF MILK BY MAN (LITERS/YR)	310.0	NRC (1977)
RATE OF INGESTION OF MEAT BY MAN (KG/YR)	110.0	NRC (1977)
RATE OF INGESTION OF LEAFY VEGETABLES BY MAN (KG/YR)	64.0	NRC (1977)
PERIOD OF LONG-TERM BUILDUP FOR ACTIVITY IN SOIL (YEARS)	15.0	NRC (1977)
EFFECTIVE SURFACE DENSITY OF SOIL (KG/SQ. M), DRY WEIGHT. (ASSUMES 15-CM PLOW LAYER)	225.0	DOE (1987)
FRACTION OF RADIOACTIVITY RETAINED ON LEAFY VEGETABLES AND PRODUCE AFTER WASHING	1.0	DOE (1987)

SITE INFORMATION	
HEIGHT OF LID	800 (M)
RAINFALL RATE	21.7 (CM/Y)
AVERAGE AIR TEMPERATURE	5.8 (DEG C) [279.0 (K)]
SURFACE ROUGHNESS LENGTH (Z0)	0.010 (M)

FOOD SUPPLY FRACTIONS	LOCAL	REGIONAL	IMPORTED	REFERENCE
VEGETABLE:	0.700	0.000	0.300	DOE (1987)
MEAT:	0.442	0.000	0.558	DOE (1987)
MILK:	0.399	0.000	0.601	DOE (1987)

Note: Variables not listed here are assigned the default values for CAP-88.

DEPOSITION VELOCITIES, SCAVENGING COEFFICIENTS, AND SETTLING VELOCITIES

CATEGORY	DEPOSITION VELOCITY (m/s)
Noble gases	0.0
Reactive gases	0.035
Organic iodine	0.00018
Particulates	0.0018

REFERENCES

DOE (U.S. Department of Energy), 1987, *Environmental Assessment: Fuel Processing Restoration at the Idaho National Engineering Laboratory*, DOE/EA-0306.

EPA (U.S. Environmental Protection Agency), 1989, *Risk Assessments Methodology, Environmental Impact Statement, NESHAPS for Radionuclides, Background Information Document - Volume 1*, EPA/520/1-89-005.

ICRP (International Commission on Radiological Protection), 1975, *International Commission on Radiological Protection, Task Group Report on Reference Man, ICRP Publication 23*, Pergamon Press, NY.

NRC (U.S. Nuclear Regulatory Commission), 1977, *Regulatory Guide 1.109 Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50 Appendix I*, Revision 1.

APPENDIX E

Supplemental Information

SUPPLEMENTAL INFORMATION

The following information is provided at the request of DOE Headquarters and is not required as part of the annual NESHAPs reporting requirements.

REQUEST: **Provide an estimate of collective effective dose equivalent (person-rem/yr) for 1998 releases.**

An estimate of collective effective dose equivalent (person-rem/yr) is provided in the *Idaho National Engineering and Environmental Laboratory Site Environmental Report for Calendar Year 1998 (DOE/ID-12082(98))*. This collective effective dose equivalent is calculated using the Mesoscale Diffussion (MDIFF) model and not CAP-88.

REQUEST: **Provide information on the status of compliance with subparts Q and T of 40 CFR Part 61 if pertinent.**

Subparts Q and T of 40 CFR 61 are not pertinent to the INEEL.

REQUEST: **Although exempt from Subpart H, provide information on Rn-220 emission from sources containing U-232 and Th-232 where emissions potentially can exceed 0.1 mrem/yr to the public or 10% of the nonradon dose to the public.**

Not applicable at the INEEL.

REQUEST: **Provide information on nondisposal/nonstorage sources of Rn-222 emissions where emissions potentially can exceed 0.1 mrem/yr to the public or 10% of the nonradon dose to the public.**

Not applicable at the INEEL.

REQUEST: **For the purpose of assessing facility compliance with the NESHAPs effluent monitoring requirements of Subpart H under Section 61.93(b), give the number of emission points subject to the continuous monitoring requirement, the number of these emission points that do not comply with the Section 61.93(b) requirements,**

and if possible, the cost for upgrades. Describe site periodic confirmatory measurement plans. Indicate the status of the QA program described by Appendix B, Method 114.

During CY 1997, the INEEL had six emission points that were subject to continuous compliance monitoring requirements as required by NESHAPs. All six emission points comply with 40 CFR 61.93(b) requirements during normal operations.

DOE-ID has implemented an INEEL Periodic Confirmatory Measurements Program. The guidance was issued in 1992. Radiological atmospheric release points were divided into categories for implementing confirmatory measurements. Those emission points with a potential unabated emission greater than or equal to 0.1 mrem/year require continuous compliance monitoring per 40 CFR 61.93. Periodic confirmatory measurements in the form of annual grab samples are required for emission sources where unabated emissions could result in an EDE between 0.01 and 0.1 mrem/year. For an estimated EDE of less than 0.01 mrem/year for a release point, as a minimum the source must be evaluated annually based upon process knowledge and the last 12 months of operation.

In 1997, each contractor performed the required periodic confirmatory measurements. Each vent was characterized and evaluated through continuous monitoring, grab sampling, or process knowledge. The results of the confirmatory measurements are on file with each contractor. Six radiological release points at the INEEL require continuous monitoring, approximately 45 additional release points were confirmed with either grab sampling or continuous sampling (not required by 40 CFR 61.93), and the remaining release points were confirmed through process knowledge and the last 12 months of operation. The New Waste Calcining Facility (NWCF) cell ventilation stack was redesigned this year (1997) to be a continuous compliance monitored stack.

Quality Assurance requirements specific to NESHAPs are specified in the *INEEL Environmental Monitoring Plan*. As a minimum, each INEEL facility with an emission potential of 0.1 mrem/yr (assuming no allowance for pollution control equipment) is required to implement the NESHAPs QA requirements. To verify compliance, contractor QA plans have been reviewed against the NESHAPs QA requirements.